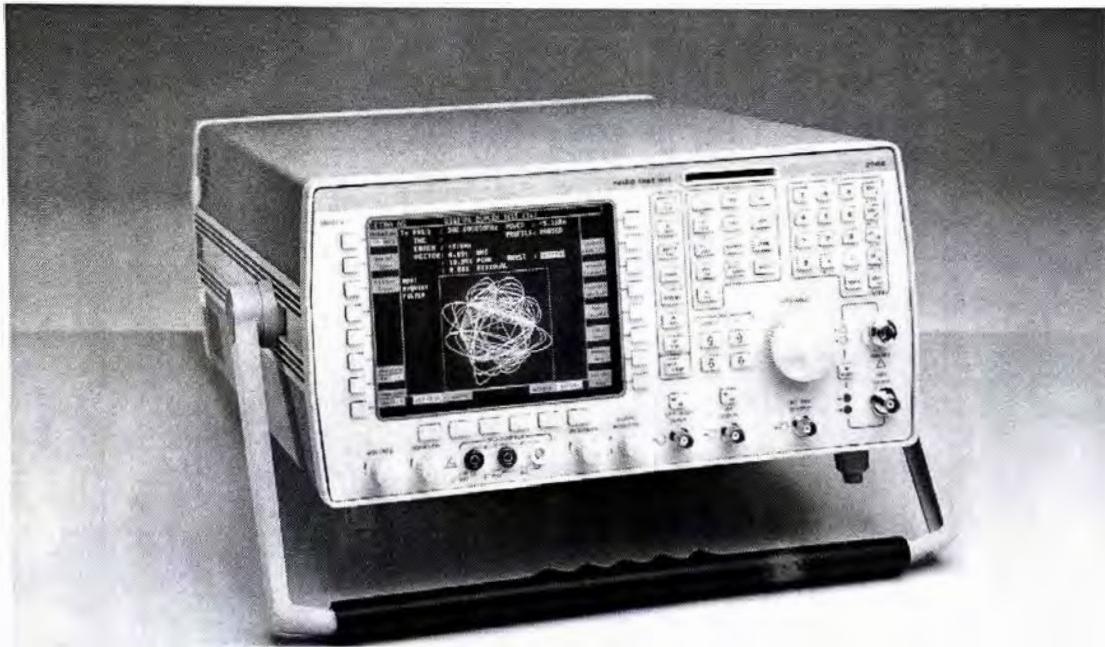




# RADIO TEST SET

**2968 for TETRA  
Phase 1**



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REF: 3042

**Operating Manual Supplement**  
46882-324Z

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**Contains**

**Operating Manual Supplement**

***for***

**RADIO TEST SET**

**2968**

**for TETRA**

**Phase 1**

**Part number 46882-324Z**

**Issue 2**

**Creation date 15-Jul-98**

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# **RADIO TEST SET**

# **2968**

## **for TETRA**

### **Phase 1**

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# About this manual

This manual explains how to operate the TETRA test system (phase 1) in the 2968 Radio Test Set:-

It applies to test sets with versions 9.0x of software 31779/258A fitted to A6/2.

## Intended audience

People who need to test the performance of TETRA mobile radios and base stations. It is assumed that the reader will either have a working knowledge of the test set or access to its Operating Manual, and will be familiar with TETRA telecommunication terms.

## Structure

### Chapter 1

Introduction and performance data.

### Chapter 2

Operating instructions for testing TETRA equipment.

### Appendix A

Glossary of terms and abbreviations used in this manual

### Index

## Document conventions

The following conventions apply throughout this manual:-

- AUTORUN      Screen text, such as menu titles and messages, is shown verbatim in this font.  
[SYSTEMS]      Hard key titles are indicated by normal lettering in square brackets.  
*[SET-UP]*      Soft key titles are shown in italic lettering in square brackets.

## Associated publications

Other manuals that cover specific aspects of this test set are:-

- **Operating Manual** (46882-274T) describes the test set
- **Programming Manual** (46882-280M) provides programming information for those wishing to write their own test programs

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# Chapter 1

## GENERAL INFORMATION

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### Introduction

The Systems mode of the 2968 Test Set enables you to test radio communication equipment such as mobile radios and base stations. The inbuilt software configures the Test Set to make measurements on signals produced by equipment operating on the selected system and produces signals structured to that system.

This manual refers to the use of the Test Set to test the performance of mobiles and base stations designed to operate to the TETRA specification.

The three modes of TETRA operation supported by the Test Set are:-

1. **MS** The Test Set tests signals transmitted by a mobile operating in normal trunked mode.
2. **BS** The Test Set tests signals transmitted by a base station.
3. **DM** The Test Set tests signals transmitted by a mobile operating in direct mode.

Each of these TETRA modes is provided with an individual Systems identity within the software structure of the Test Set.

The test facilities provided for the TETRA system are:-

- On-channel transmitter measurements for manufacturing and installation.
- T1 test signal generator supports conformance testing.
- Comprehensive modulation analysis with constellation and phase trajectory diagrams.
- Base station control channel simulation to provide effective network simulation.
- Demodulated burst data capture to aid diagnosis of system problems.

### Capability

#### Transmitter tests

The Test Set is able to test the performance of transmitters in TETRA mobiles, TETRA base stations and TEIR direct mode terminals. The specific test capabilities are:-

- Tx power; burst and continuous.
- Tx level control. (Mobile only.)
- Tx Frequency error.
- Burst profiles.
- Modulation accuracy for peak and RMS vector error.
- Constellation and phase trajectory diagrams.

Measurements can be made on *on-channel* signals without signalling or synchronization, for manufacturing applications where radios can be operated in test modes.

#### Frequency setting

When the Test Set is operating in Systems mode, the RF signal generator and the receiver within the Test Set can only be set as Channel Numbers. If you enter the Duplex test mode from Systems mode, you can set the GEN FREQ and Tx FREQ using the data input keys.

### Receiver tests

The signal generator within the Test Set simulates Base Station signals. The signals produced are:-

- Main Control CHannel (MCCH).
- Traffic Channel (TCH).
- T1 test signals as defined in ETS 300 394-1.

#### Frequency setting

See above.

### General

When the Systems mode is selected the Test Set is set up to produce signals and make measurements appropriate to the selected system. The non-system modes of the Test Set can be used to give real time readings of equipment performance.

Figure 1-1 shows how the TETRA system interfaces with the other operating modes of the Test Set. The dashed lines indicate that you can enter one of the standard test modes by pressing the associated hard key - such as [AF TEST] or [DUPLEX TEST] - and then return directly to the TETRA system screens simply by pressing the [SYSTEMS] hard key.

### Manual testing

**Note:**.. The term *Manual Testing* as used in this manual is in line with its use in similar manuals relating to other System test software available for the test set. Other System test software such as AMPS, TACS etc. have automatic test programmes within them. Later releases of the TETRA System test software will provide this facility; the term *Automatic Testing* will then be used as well as *Manual Testing*.

The Manual test mode provides manual control of the simulated base station signal produced by the Test Set. It enables you to test specific parts of the operation of the equipment under test. This is useful for fault finding or adjustment of the equipment under test. (Automatic tests, using automatic test programs are planned for later phases of the TETRA Systems software.)

## Connections

Prior to testing, you must connect one of the RF connectors (N-type or TNC) on the Test Set to the antenna connector of the equipment under test using a suitable RF cable. See *Testing mobiles and base stations; Preparing to test*, in Chapter 2 of this manual.

Mode keys shown grey  
are not active from TETRA or  
GSM systems modes

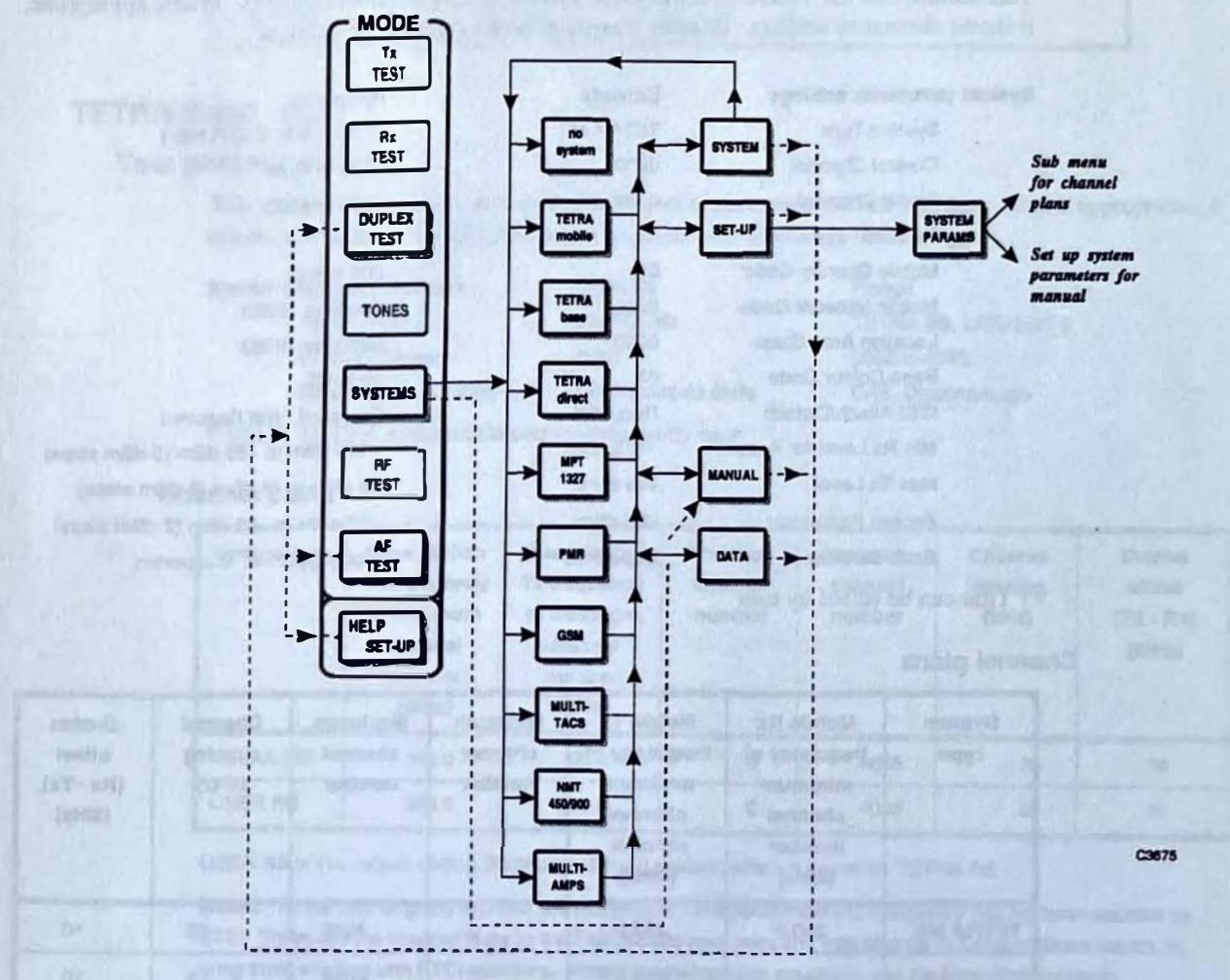


Fig. 1-1 TETRA Systems interface with main Test Set modes

## Remote operation

The TETRA Systems modes can be operated using the GPIB or RS232 remote control facilities provided on the Test Set.

## Performance data

The performance data shown below is provided in addition to that contained in the operating manual for 2965A, 2966A, 2967 and 2968 (IFR part number 46882-274T).

### TETRA Mobile (MS)

#### Test parameters

This section lists the TETRA Mobile (MS) System parameter default settings. Where appropriate, it shows alternative settings. Chapter 2 explains how to change the settings.

System parameter settings	Defaults	Range
System Type	TETRA MS	TETRA MS, USER MS †
Control Channel	0000	0000 to 4095
Traffic Channel	0000	0000 to 4095
Timeslot	1	1 to 4
Mobile Country Code	001	001 to 999
Mobile Network Code	00001	00000 to 16383
Location Area Code	00001	00000 to 16383
Base Colour Code	01	00 to 63
ITSI Attach/Detach	Required	Required, Not Required
Min Rx Level for Access	-125 dBm	-125 dBm to -50 dBm (5 dBm steps)
Max Tx Level	+45 dBm	+15 dBm to 45 dBm (5 dBm steps)
Access Parameter	-53 dBm	-23 dBm to -53 dBm (2 dBm steps)
Base Services	Supported	Not Supported, Supported

† Title can be edited by user

#### Channel plans

System type	Mobile Rx frequency of minimum channel number (MHz)	Mobile Tx frequency of minimum channel number (MHz)	Minimum channel number	Maximum channel number	Channel spacing (kHz)	Duplex offset (Rx - Tx) (MHz)
TETRA MS	390.0	380.0	0	4095	25	10
USER MS	390.0	380.0	0	4095	25	10

USER MS is the default setting of the user-defined system, which is based on TETRA MS

**Note:** At the time of going to press, the mapping of *Channel Numbers* to *Frequency* has not been decided by ETSI. Therefore the channel plans in the Test Set are presumed and may change in future software issues, to bring them into line with ETSI decisions. Where inconsistencies are found, use the *User Defined* plans.

### Mobile transmitter power levels

Control level	Nominal output power		Comments
MS PL1	45 dBm	30 W	Power Class 1 Max Power
MS PL2	40 dBm	10 W	Power Class 2 Max Power
MS PL3	35 dBm	3 W	Power Class 3 Max Power
MS PL4	30 dBm	1 W	Power Class 4 Max Power
MS PL5	25 dBm	300 mW	
MS PL6	20 dBm	100 mW	
MS PL7	15 dBm	30 mW	

### TETRA Base (BS)

#### Test parameters

This section lists the TETRA Base (BS) System parameter default settings. Where appropriate, it shows alternative settings. Chapter 2 explains how to change the settings.

System parameter settings	Default	Range
System Type	TETRA BS	TETRA BS, USER BS †
Control Channel	0000	0000 to 4095
Base Station Tx Mode	Continuous All Slots	CAS, Discontinuous

† USER TETRA system title can be defined by user

#### Channel plans

System type	Base station Rx frequency of minimum channel number (MHz)	Base station Tx frequency of minimum channel number (MHz)	Minimum channel number	Maximum channel number	Channel spacing (kHz)	Duplex offset (Tx - Rx) (MHz)
TETRA BS	380.0	390.0	0	4095	25	10
USER BS	380.0	390.0	0	4095	25	10

USER BS is the default setting of the user-defined system, which is based on TETRA BS

**Note:** At the time of going to press, the mapping of *Channel Numbers* to *Frequency* has not been decided by ETSI. Therefore the channel plans in the Test Set are presumed and may change in future software issues, to bring them into line with ETSI decisions. Where inconsistencies are found, use the *User Defined* plans.

#### Base station transmitter power classes

Control level	Nominal output power	
BS Class 1	46 dBm	40 W
BS Class 2	44 dBm	25 W
BS Class 3	42 dBm	16 W
BS Class 4	40 dBm	10 W
BS Class 5	38 dBm	6 W
BS Class 6	36 dBm	4 W
BS Class 7	34 dBm	2.5 W
BS Class 8	32 dBm	1.6 W
BS Class 9	30 dBm	1.0 W
BS Class 10	28 dBm	600 mW

## GENERAL INFORMATION

### TETRA Direct Mode (DM)

#### Test parameters

This section lists the TETRA Direct Mode (DM) System parameter default settings. Where appropriate, it shows alternative settings. Chapter 2 explains how to change the settings.

System parameter settings	Defaults	Range
System type	TETRA DM	TETRA DM, USER DM †
Channel	0000	0000 to 4095

† Title can be edited by user

#### Channel plans

System type	Mobile Rx frequency of minimum channel number (MHz)	Mobile Tx frequency of minimum channel number (MHz)	Minimum channel number	Maximum channel number	Channel spacing (kHz)
TETRA DM	380.0	380.0	0	4095	25
USER DM	380.0	380.0	0	4095	25

USER DM is the default setting of the user-defined system, which is based on TETRA DM

Note: At the time of going to press, the mapping of *Channel Numbers* to *Frequency* has not been decided by ETSI. Therefore the channel plans in the Test Set are presumed and may change in future software issues, to bring them into line with ETSI decisions. Where inconsistencies are found, use the *User Defined* plans.

#### Mobile transmitter power levels

In Direct Mode (DM) all mobiles operate at their maximum power level apart from Power Class 1 mobiles, which operate at power level 2.

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## Chapter 2

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## Introduction

This chapter explains how to use the test set to carry out tests on TETRA mobiles and base stations. The instructions given assume that you are familiar with the basic operation of the test set in its various modes and that it has been prepared for use as described in the Operating Manual supplied with the test set.

If you are unfamiliar with the test set, it is suggested that you spend a short time exploring the various menus and displays before connecting it to a mobile or base station.

The operating details that you require when using the test set in the TETRA Systems mode fall into two groups:-

- Testing of individual mobiles or base stations. You decide on the procedures required for the particular unit or batch of units, connect the equipment under test to the test set, and carry out manual tests.
- Customisation, where you change default test parameters for certain items to be tested or specific test requirements.

The set-up menus of the Systems mode give you control of the test system parameters. Once set to your requirements, the test set will retain the settings for both immediate and future use.

Different settings can be stored within the test set or on memory cards - refer to the section *Store and recall facility* on page 2-35.

### Before starting

It is recommended, in line with best practice in electronic measurements, that the working temperature of the test set is allowed to stabilise before commencing tests. Refer to *Frequency Standard* in the performance data section of the operating manual 46882-274T.

### System selection

In addition to the TETRA mobile, TETRA base station and TETRA direct mode systems described in this manual, other test systems are available with this test set. Initially<sup>1</sup> the [SYSTEMS] hard key displays a SYSTEM SELECTION menu showing the installed systems - see Fig. 2-1. The titles of systems that are not installed (but are available for the test set) are shown in dim video.

**Note**

If a tones mode menu or a help screen is displayed, then the [*return*] soft key for that display must be used to return the test set to a mode from which Systems mode can be selected.

<sup>1</sup> The first time that the [SYSTEMS] key is pressed after switch-on. Otherwise the latest Systems screen appears.

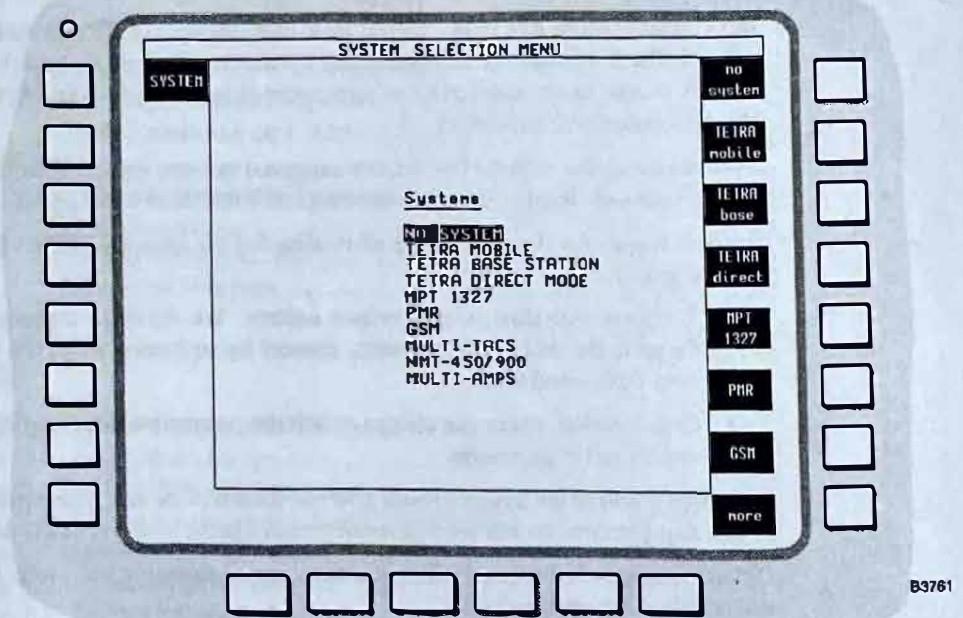


Fig. 2-1 System selection menu.

### Selecting the system

The SYSTEM SELECTION MENU assigns one soft key to each system. The three TETRA test modes outlined in Chapter 1 are each programmed as individual Systems within the test set. To select the TETRA mobile, TETRA base station or TETRA direct mode system, press the [TETRA mobile], [TETRA base] or [TETRA direct] soft key as appropriate.

Having selected the system, you can select variants by pressing keys in the following order:

[SET-UP], [system type].

This gives you access to the appropriate set of keys:-

[TETRA MS], [USER TETRA] and [edit USER];

or

[TETRA BS], [USER TETRA] and [edit USER];

or

[TETRA DM], [USER TETRA] and [edit USER];

The procedure is described in detail on pages 2-29, (TETRA MS), 2-31, (TETRA BS) and 2-32, (TETRA DM)

The title of the selected system variant is shown at the top left of the display. This continues to be displayed on all screens until the [no system] key on the SYSTEM SELECTION MENU is pressed or until a different system or system variant is selected.

The displayed titles corresponding to the system variants described above are:-

<i>[TETRA MS],</i>	→	TETRA MS
<i>[USER TETRA]</i>	→	USER MS
<i>[TETRA BS],</i>	→	TETRA BS
<i>[USER TETRA]</i>	→	USER BS
<i>[TETRA DM],</i>	→	TETRA DM
<i>[USER TETRA]</i>	→	USER DM

With a TETRA system selected, four of the soft keys at the left of the screen are allocated to explicit functions or user operations. This follows the general philosophy of the test set design. The keys and their functions are shown below:-

- [SYSTEM]** System selection menu
- [SET-UP]** System set-up menus
- [MANUAL]** Manual test mode
- [DATA]** Data display mode

## Testing mobiles and base stations

This section describes manual testing.

For most users of the test set, the default settings for the selected system will be appropriate and the test set can be used for testing TETRA equipment without making changes to the system parameters. The default settings are listed in Chapter 1 of this supplement under *Performance data*.

Procedures for changing the parameters are given in the section *Customising the system*, starting on page 2-27.

**Note**

Measurements can only be made on bursts with a valid training sequence.

### Preparing to test

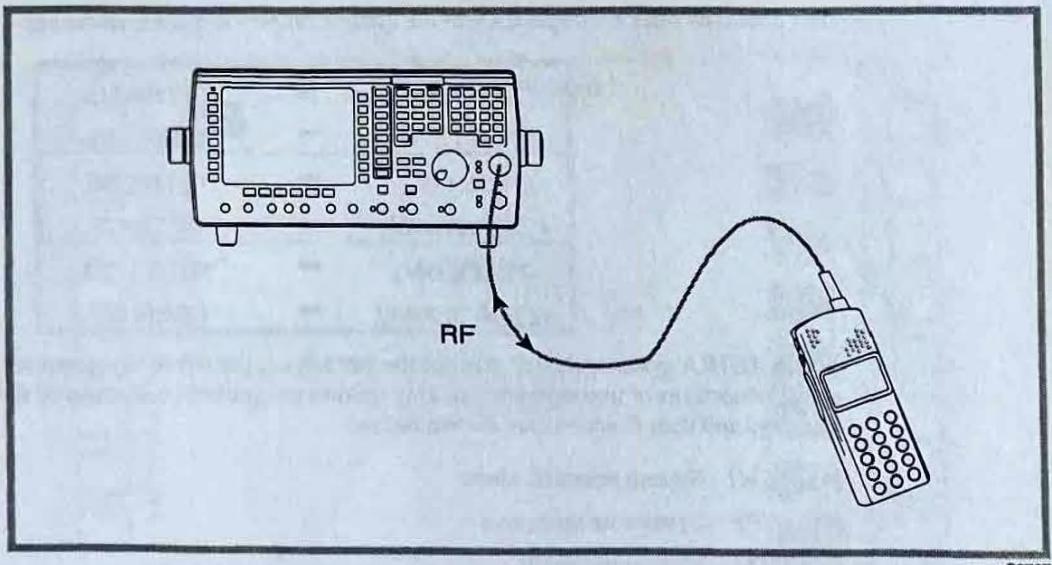
#### Connections

The mobile or base station to be tested must have an RF connection to the test set.

1. Ensure that the mobile or base station to be connected is not powered up.
2. Use a suitable RF cable (and adapter if required) to connect the antenna connection on the mobile or base station to be tested, to one of the RF connectors (N-type or TNC) on the test set.
3. Use the [RF SELECT] hard key if necessary to select the appropriate test set connector (but see note below). A typical test set-up is shown in Fig. 2-2.

**CAUTION**

If you enter Digital DUPLEX TEST mode from Systems mode, then change the setting of the [RF SELECT] key, the original selection will be reset when you return to Systems mode.



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*Fig. 2-2 A typical test set-up.*

### Interference

Plastic-cased mobiles tend to be susceptible to interference and also may pick up transmissions from Base Stations. This can affect the recognition of the simulated control channel, and also mobile receiver tests when the test set RF generator output is low. If interference is a problem, you are advised to place the mobile in a screened enclosure where possible.

### Manual testing

**Note:** The term *Manual Testing* as used in this manual is in line with its use in similar manuals relating to other System test software available for the test set. Other System test software such as AMPS, TACS etc. have automatic test programmes within them. Later releases of the TETRA System test software will provide this facility; the term *Automatic Testing* will then be used as well as *Manual Testing*.

You select the Manual test mode by pressing the [*MANUAL*] soft key. This mode is provided to assist you in fault location and repair.

The different aspects of the system operation can be tested by using the appropriate soft keys.

The test procedures for manual testing vary for each of the TETRA systems and these are described in three sections.

- TETRA mobile starts on page 2-8.
- TETRA base station starts on page 2-13.
- TETRA direct mode starts on page 2-14.

However, there are some common features which are described below.

### Switching between test modes

When the test set is operating in Systems manual mode within one of the TETRA systems, you can change to DUPLEX TEST or AF TEST by pressing the appropriate MODE key. When you do this, the equipment under test remains active and all the settings of the test mode relate to the ongoing manual test. This allows measurements to be made on the receiver or transmitter of the equipment under test. You can return directly to the Systems manual test by pressing the [SYSTEMS] hard key.

From DUPLEX TEST mode, you can access the spectrum analyzers, RF power analyzer and constellation diagrams displays.

Further information about duplex testing is given later in this chapter, starting on page 2-16.

## Using the HELP SET-UP mode

Within the HELP SET-UP facility there are screens to allow you to select various options relating to the Tx measurement procedures for manual tests.

You can set the number of bursts that will be used to determine each of the measurements tabled below and whether the value obtained is the average of all readings or the worst case obtained. The number of readings can be set within the range 1 to 250. The measurements are:-

- Power.
- Frequency error.
- RMS vector error.
- Peak vector error.
- Residual carrier.

The Tx settings are accessed via the SET-UP OPTIONS: DIGITAL SYSTEMS screen, which you display by the following key sequence:-

[HELP SET-UP], [SET-UP], [TEST OPTIONS], [digital systems].

Then press the [TETRA Tx meas] key to display the SET-UP OPTIONS: TETRA Tx SAMPLES screen.

To change the number of samples taken for a particular measurement, press the appropriate soft key to highlight the measurement, then key in the required number of samples and press the [ENTER] key.

To reset the number of samples taken for all measurements to the default values press the [default values] key.

To change the measurement type, press the [Tx meas type] key to toggle between WORST CASE and AVERAGE.

## Highlighted measurements

### Measurement inaccuracies

In particular cases where there is some doubt about the accuracy of a test measurement, the displayed result is highlighted by appearing in inverse video. This may be only temporary, for example:-

While the test set is collecting sufficient samples to make the measurements statistically valid, the intermediate result is shown in inverse video. Once sufficient samples have been collected the displayed result returns to normal video.

Other examples are given where appropriate.

### RF level offsets

If an RF input or output level offset has been set via the HELP AND SET-UP menu, this will be highlighted on the screen by an asterisk (\*) in inverse video beside the RF generator level or power measurement.

## TETRA mobile manual testing

The TETRA MS test arrangement is shown below.

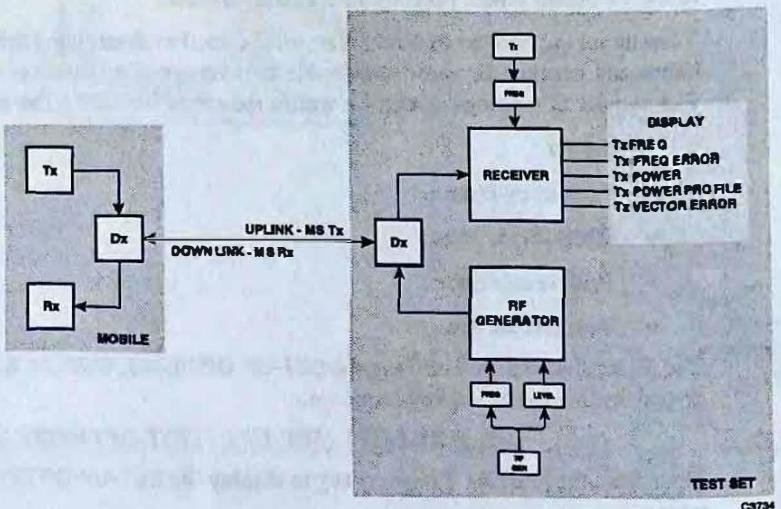


Fig. 2-3 TETRA MS test arrangement.

### Special mobile test modes

The TETRA MS test system has the capability to test mobiles with TCH test capability. This facility within some TETRA mobiles, allows the mobile to produce traffic channel signals when given relevant manufacturer specific instructions (via the keypad or test interface), rather than only after receiving instructions from a base station (or a test set) over the air interface.

A facility within some TETRA mobiles is a capability to produce specific test signals when so instructed over the air interface. The TETRA MS test system is able to produce the T1 test signals required to access this facility, and to perform measurements on the resultant signals from the mobile.

See *T1 test mode* starting on page 2-10 and *TCH test mode* starting on page 2-11.

### Selecting the manual test mode

You select the Manual test mode by pressing the *[MANUAL]* soft key.

The different aspects of the system operation can be tested by using the appropriate soft keys.

The top level MANUAL TEST screen shown in Fig. 2-4 is displayed.

The MODE indicator displays MCCH to show that the test set is generating a MAIN CONTROL CHANNEL.

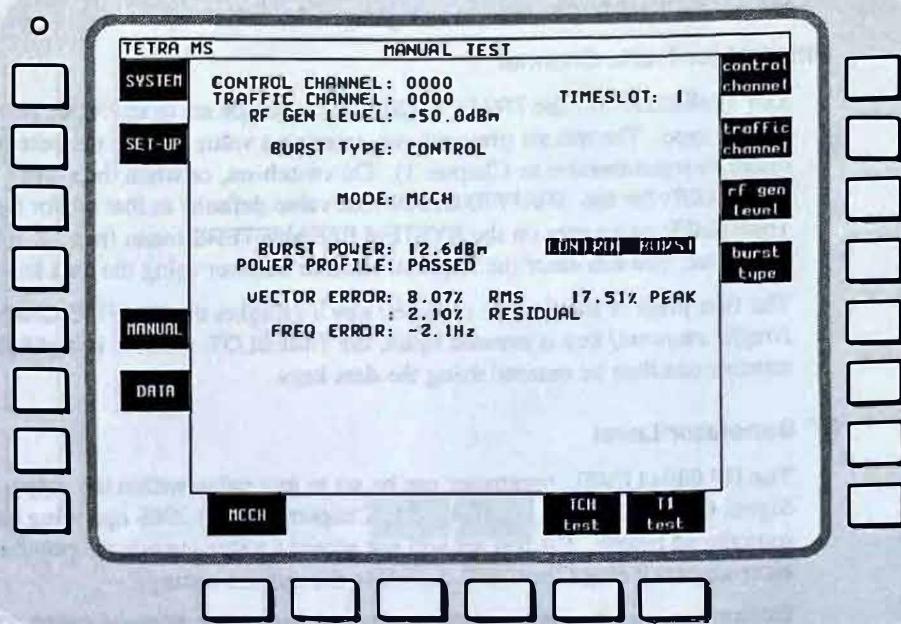


Fig. 2-4 Manual test screen (top level), TETRA MS.

From this screen you can change the settings of the parameters listed below to suit your requirements:-

- Control Channel (Sets the frequency of the receiver within the Test Set.)
- Traffic Channel (Sets the frequency of the receiver within the Test Set.)
- Traffic Channel Timeslot
- RF Generator Level
- Burst type

#### Control Channel

The CONTROL CHANNEL: can be set to any value permitted by the selected system type. The test set prevents you entering a value outside the permitted limits (specified under *Test parameters* in Chapter 1). On switch-on, or when the system is re-selected, the CONTROL CHANNEL: value defaults to that set for the CONTROL CHANNEL: parameter on the SYSTEM PARAMETERS menu (page 2-30). If you want to change this value, you can enter the required channel number using the data keys. The TIMESLOT: for the CONTROL CHANNEL: is always TN 1.

**Note:** At the time of going to press, the mapping of *Channel Numbers to Frequency* has not been decided by ETSI. Therefore the channel plans in the Test Set are presumed and may change in future software issues, to bring them into line with ETSI decisions. Where inconsistencies are found, use the *User Defined* plans.

#### Traffic Channel

See note above.

The TRAFFIC CHANNEL: can be set to any value permitted by the selected system type. The test set prevents you entering a value outside the permitted limits (specified under *Test parameters* in Chapter 1). On switch-on, or when the system is re-selected, the TRAFFIC CHANNEL: value defaults to that set for the TRAFFIC CHANNEL: parameter on the SYSTEM PARAMETERS menu (page 2-30). If you want to change this value, you can enter the required channel number using the data keys.

The first press of the [traffic channel] key highlights the TRAFFIC CHANNEL: number. A

different number can then be entered using the data keys. If the *[traffic channel]* key is pressed twice, the TIMESLOT: number is highlighted (see below).

#### Timeslot for Traffic Channel

The TIMESLOT: for the TRAFFIC CHANNEL: can be set to any value permitted by the selected system type. The test set prevents you entering a value outside the permitted limits (specified under *Test parameters* in Chapter 1). On switch-on, or when the system is re-selected, the TIMESLOT: for the TRAFFIC CHANNEL: value defaults to that set for the TRAFFIC CHANNEL: TIMESLOT: parameter on the SYSTEM PARAMETERS menu (page 2-30). If you want to change this value, you can enter the required channel number using the data keys.

The first press of the *[traffic channel]* key highlights the TRAFFIC CHANNEL: number. If the *[traffic channel]* key is pressed again, the TIMESLOT: number is highlighted. A different number can then be entered using the data keys.

#### RF Generator Level

The RF GEN LEVEL: parameter can be set to any value within the output range of the Digital Signal Generator. This is specified in Chapter 1 of the 2968 operating manual, 46882-274T and reproduced below. The test set will not accept a value outside the possible range; attempting to enter an out of range level will default to the current setting.

#### Extract from performance data section of Operating Manual 46882-274T

RF signal generator, digital	
2968 (TETRA)	
Receiver test and two-port duplex test:-	
N-type RF socket	-135 dBm to -40 dBm
TNC RF socket	-135 dBm to -20 dBm
One-port duplex test:-	
N-type RF socket	-135 dBm to -50 dBm
TNC RF socket	-135 dBm to -30 dBm

#### Burst type

The burst type can be set to NORMAL, CONTROL or NORMAL/CONTROL. The test set will measure the selected burst type and disregard bursts of the alternative type. If NORMAL/CONTROL is set all bursts will be measured. To change the BURST TYPE: setting, first press the *[burst type]* key, then select from the new soft keys.

#### T1 test mode

Selecting the T1 test mode displays the screen shown in Fig. 2-5. In this mode the test set generates test signals - known as T1 test signals - for conformance testing of TETRA mobile radios, as defined in ETS 300 394-1.

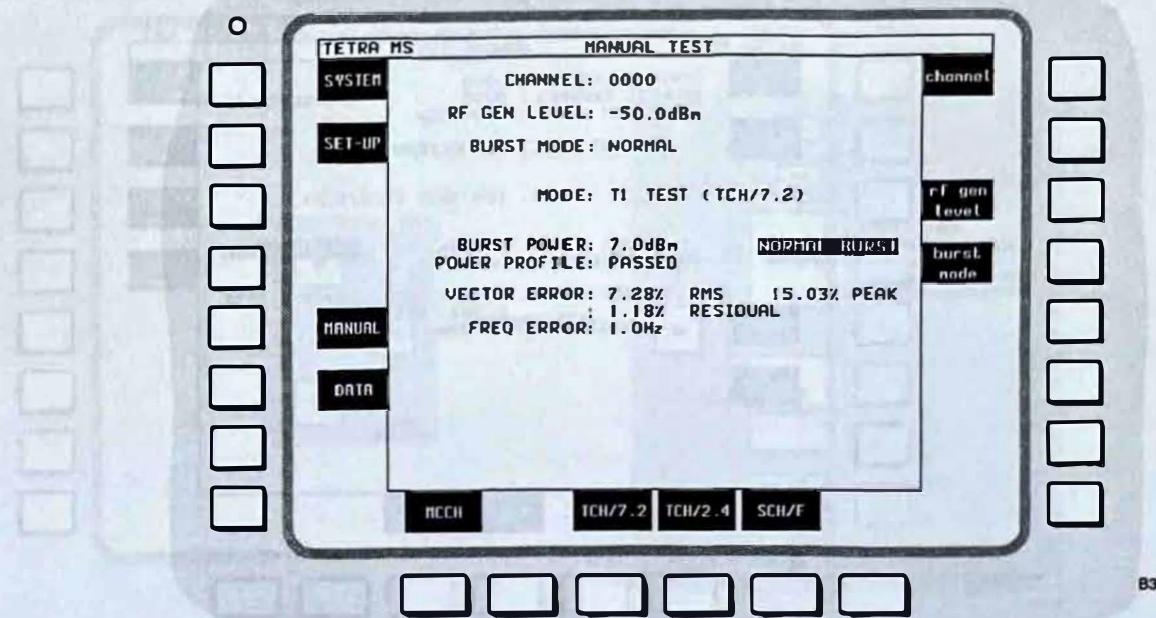


Fig. 2-5 Manual test T1 test mode.

Three T1 signal types are provided:-

TCH/7.2

TCH/2.4

SCH/F

The required signal type is selected by pressing the appropriate soft key. Descriptions of the three signal types are given below, followed by details of the function of the other soft keys on the top level T1 test screen.

[TCH/7.2] A T1 type 1 signal is generated. Frames 1 to 17 of the TN1 carry O. 153 PRBS data, coded as TCH/7.2, indicated in BNCH/T T1 burst type.

[TCH/2.4] A T1 type 4 signal is generated. Frames 1 to 17 of TN1 carry O. 153 PRBS data, coded as TCH/2.4, indicated in BNCH/T T1 burst type.

[SCH/F] A T1 type 2 signal is generated. Frames 1 to 17 of TN1 carry O. 153 PRBS data, coded as SCH/F, indicated in BNCH/T T1 burst type.

[MCCH] Re-establishes the MCCH mode.

[channel] Controls the frequency of the receiver and generated T1 signal.

[rf gen level] Controls the level of the generated T1 signal.

[burst mode] Allows selection of the type of burst generated by the mobile and measured by the test set. The options are; CONTROL, NORMAL, NONE. These options affect the Tx ON and Tx burst type parameters in the T1 BNCH/T information.

### TCH test mode

Selecting the TCH test mode displays the screen shown in Fig. 2-6. In this mode you are able to carry out tests on mobiles that have special test modes, e.g. mobiles that can be set into specific states via the keypad or via a PC. It forces the test set to generate a traffic channel frame structure in accordance with the system set-up parameters. It does not perform any signalling to put the mobile on a traffic channel.

The test set operates in *open receiver* (unsynchronized) mode and displays measurements for any bursts that it receives from the mobile.

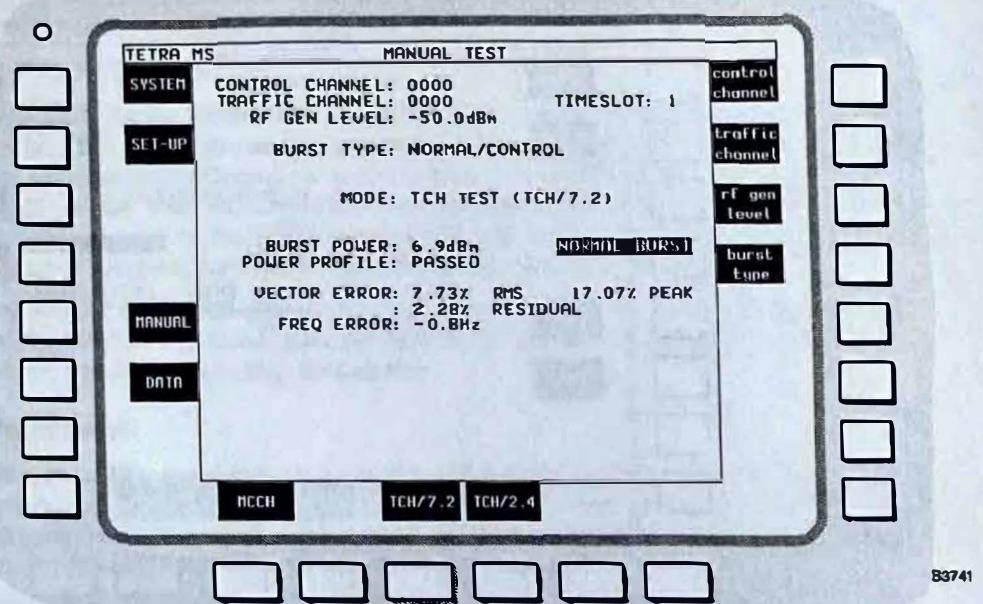


Fig. 2-6 Manual test TCH mode.

Two signal types are provided:-

TCH/7.2      TCH/2.4

The required signal type is selected by pressing the appropriate soft key. Descriptions of the signal types are given below, followed by details of the function of the other soft keys on the top level TCH test screen.

**[TCH/7.2]** A TCH7.2 1 signal is generated. Frames 1 to 17 of the selected timeslot carry O. 153 PRBS data, coded as TCH/7.2.

**[TCH/2.4]** A TCH 2.4 signal is generated. Frames 1 to 17 of the selected timeslot carry O. 153 PRBS data, coded as TCH/2.4.

**[MCCH]** Re-establishes the MCCH mode.

**[control channel]** Controls the frequency of the receiver and generated MCCH signal.

**[traffic channel]** Controls the frequency of the receiver and generated TCH signal.

**[rf gen level]** Controls the level of the generated TCH signal.

**[burst type]** Allows selection of the type of burst measured by the test set. The options are: NORMAL, CONTROL, NORMAL/CONTROL.

### Data displays

To enable the data display mode, press the **[DATA]** soft key at the left side of the screen.

The data display mode allows you to view demodulated data received by the test set.

## TETRA base station manual testing

The TETRA BS test arrangement is shown below.

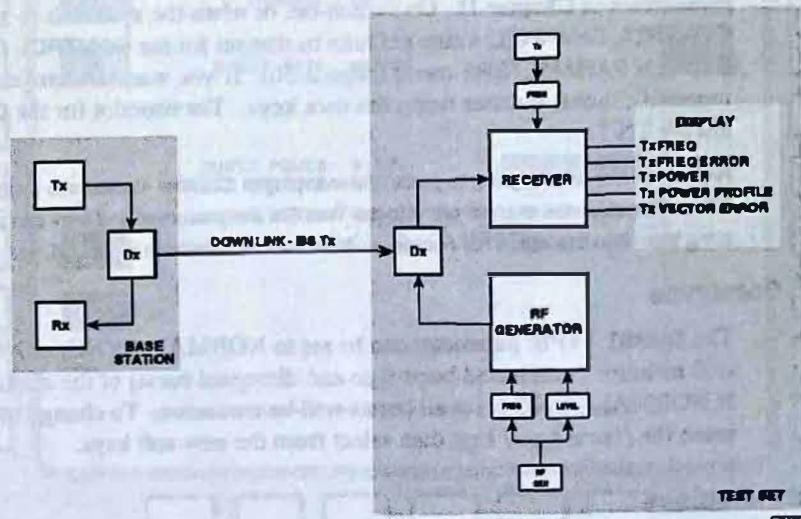


Fig. 2-7 TETRA BS test arrangement.

You select the Manual test mode by pressing the [MANUAL] soft key..

The different aspects of the system operation can be tested by using the appropriate soft keys.  
The initial MANUAL TEST screen is shown in Fig. 2-8.

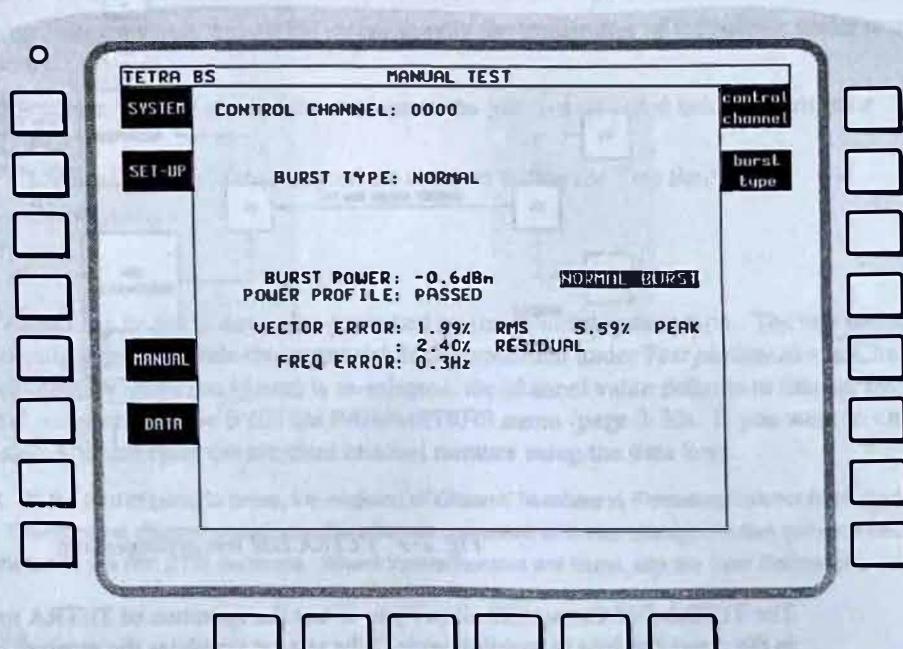


Fig. 2-8 Manual test screen (top level), TETRA BS.

From this screen you can change the settings of the parameters listed below to suit your requirements:-

- Control Channel (Sets the frequency of the receiver within the Test Set.)
- Burst type

### Control Channel

The CONTROL CHANNEL: can be set to any value permitted by the selected system type. The test set prevents you entering a value outside the permitted limits (specified under *Test parameters* in Chapter 1). On switch-on, or when the system is re-selected, the CONTROL CHANNEL: value defaults to that set for the CONTROL CHANNEL: parameter on the SYSTEM PARAMETERS menu (page 2-30). If you want to change this value, you can enter the required channel number using the data keys. The timeslot for the CONTROL CHANNEL: is always TN 1.

**Note:** At the time of going to press, the mapping of *Channel Numbers to Frequency* has not been decided by ETSI. Therefore the channel plans in the Test Set are presumed and may change in future software issues, to bring them into line with ETSI decisions. Where inconsistencies are found, use the *User Defined* plans.

### Burst type

The BURST TYPE: parameter can be set to NORMAL, SYNC, or NORMAL/SYNC. The test set will measure the selected burst type and disregard bursts of the alternative type. If NORMAL/SYNC is set all bursts will be measured. To change the BURST TYPE: setting, first press the *[burst type]* key, then select from the new soft keys.

### Data displays

To enable the data display mode, press the *[DATA]* soft key at the left side of the screen.

The data display mode allows you to view demodulated data received by the test set.

### TETRA direct mode manual testing

The TETRA DM test arrangement is shown below.

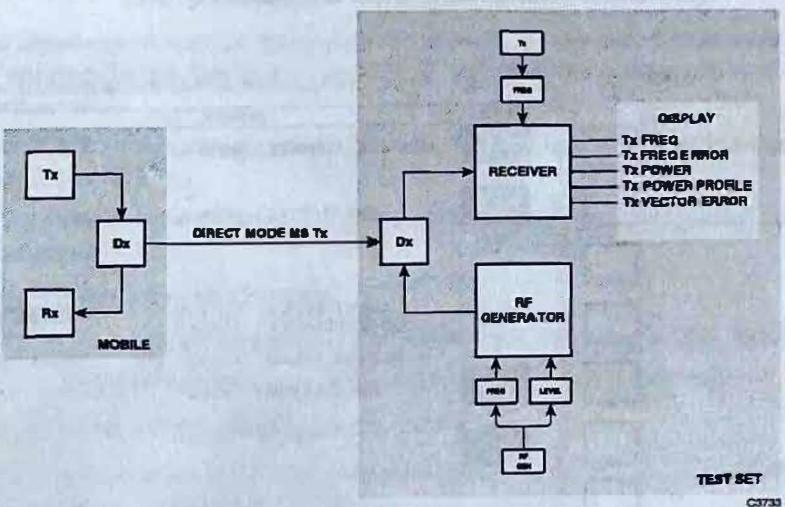


Fig. 2-9 TETRA DM test arrangement.

The TETRA DM test system allows you to test the operation of TETRA mobile radios operating in the direct (mobile to mobile) mode. The test set simulates the receiver of a mobile radio to allow you to test the operation of the transmitter of the mobile radio under test.

No signal is generated.

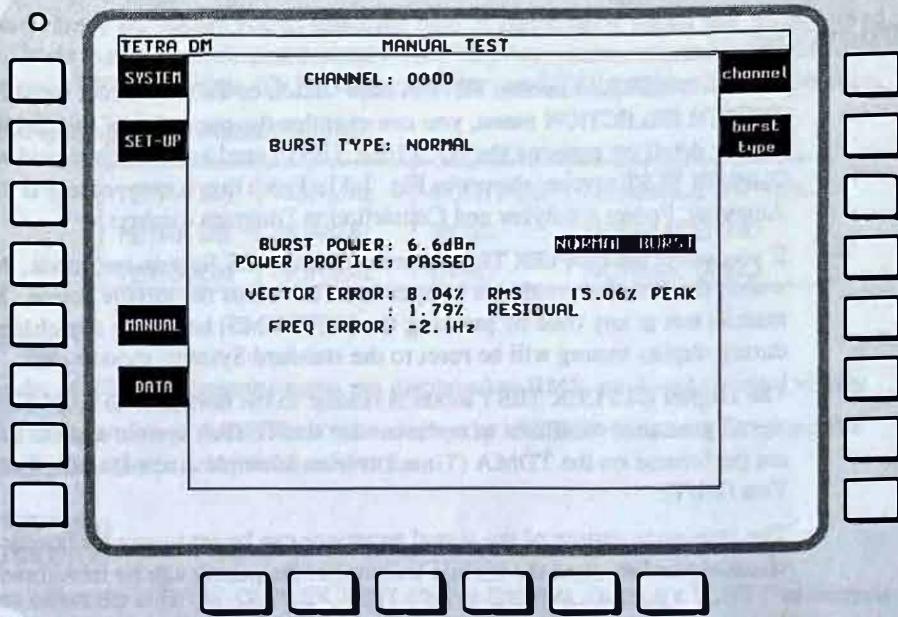


Fig. 2-10 Manual test TETRA direct mode.

### Selecting the manual test mode

You select the Manual test mode by pressing the [MANUAL] soft key.

The top level MANUAL TEST screen shown in Fig. 2-10 is displayed.

The test set does not generate an RF signal as only the transmitter of the mobile under test is being tested.

From this screen you can change the settings of the parameters listed below to suit your requirements:-

- Channel (Sets the frequency of the receiver within the Test Set.)
- Burst type

#### Channel

The Channel can be set to any value permitted by the selected system type. The test set prevents you entering a value outside the permitted limits (specified under *Test parameters* in Chapter 1). On switch-on, or when the system is re-selected, the channel value defaults to that set for the Channel parameter on the SYSTEM PARAMETERS menu (page 2-30). If you want to change this value, you can enter the required channel number using the data keys.

**Note:** At the time of going to press, the mapping of *Channel Numbers* to *Frequency* has not been decided by ETSI. Therefore the channel plans in the Test Set are presumed and may change in future software issues, to bring them into line with ETSI decisions. Where inconsistencies are found, use the *User Defined* plans.

#### Burst type

The burst type can be set to NORMAL, SYNC or NORMAL/SYNC. The test set will measure the selected burst type and disregard bursts of the alternative type. If NORMAL/SYNC is set all bursts will be measured. To change the BURST TYPE: setting, first press the [burst type] key, then select from the new soft keys.

#### Data displays

To enable the data display mode, press the [DATA] soft key at the left side of the screen.

The data display mode allows you to view demodulated data received by the test set.

## Digital duplex testing

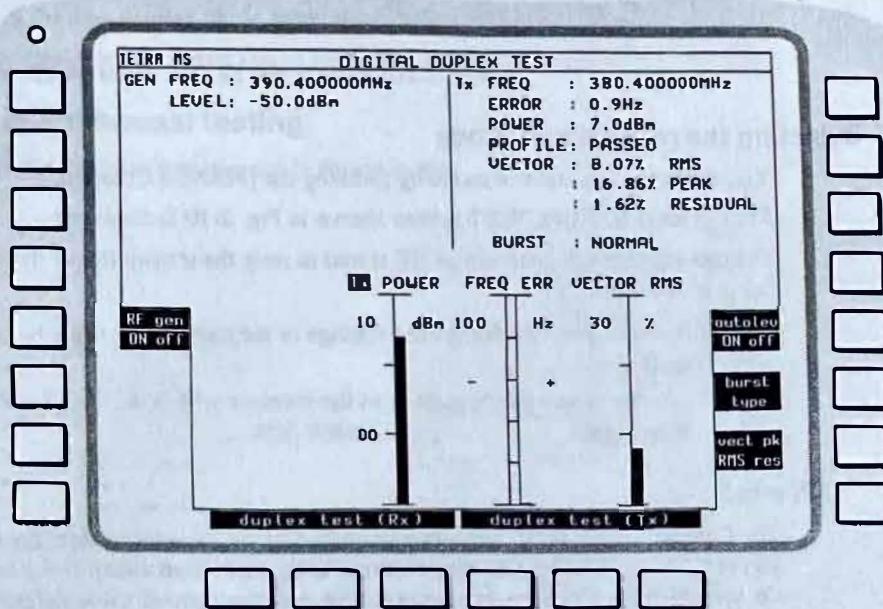
### Introduction

Whenever TETRA mobile, TETRA base station or TETRA direct mode is selected on the SYSTEM SELECTION menu, you can examine the operation of the mobile or base station in greater detail by pressing the [DUPLEX TEST] hard key, which provides access to the DIGITAL DUPLEX TEST screen, shown in Fig. 2-11. From this screen, access is obtained to the Spectrum Analyzer, Power Analyzer and Constellation Diagram displays.

If you select the DUPLEX TEST screen from the MS System test mode, the Signal Generator within the Test Set continues to operate. This keeps the mobile active. You can return to the manual test at any time by pressing the [SYSTEMS] hard key; any changes that you have made during duplex testing will be reset to the standard Systems mode values.

The Digital DUPLEX TEST mode is similar to the normal DUPLEX TEST mode. However, the signal generator continues to modulate for the TETRA system and the transmitter measurements are performed on the TDMA (Time Division Multiple Access) transmissions of the Unit Under Test (UUT).

The frequency setting of the signal generator can be set to any frequency (in Hz, rather than by channel number), and the mobile transmitter frequency can be monitored.



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Fig. 2-11 Digital duplex test screen (top-level).

The top-level DIGITAL DUPLEX TEST screen shows the frequency and output level of the RF generator (GEN FREQ, LEVEL), the test set receiver frequency (Tx FREQ), frequency error (the difference between the mobile's transmitter frequency and the test set receiver frequency), the mobile Tx power, power profile indicator, peak vector error, RMS vector error and residual carrier power. Some of these measurements are also shown in standard bar chart form.

### Automatic reference level setting

The [*autolev ON off*] soft key enables you to select whether the reference level is set automatically (this is the default) or manually. Note that auto-levelling is switched off if you use the spectrum analyzer [*ref level ▲*] soft key. If auto-levelling is switched off, the test set's receiver may not be optimally ranged, so the accuracy of transmitter measurements may be reduced; if so, the results are shown in inverse video.

## Measured burst type selection

The [*burst type*] key allows you to select the type of signal burst which will be measured. The types of burst that can be selected depend on the TETRA system selected, as explained under *Burst type* in TETRA Mobile, TETRA Base Station and TETRA Direct Mode operation.

The burst type options are tabled below:-

TETRA MS	NORMAL	CONTROL	NORMAL/CONTROL
TETRA BS	NORMAL	SYNC	NORMAL/SYNC
TETRA DM	NORMAL	SYNC	NORMAL/SYNC

## Vector readings

The results of VECTOR measurements are displayed as RMS, peak and residual values.

You can select which of these values is shown by the VECTOR bar chart. Pressing the [*vect pk RMS res*] will select each in rotation.

### DIGITAL DUPLEX TEST (Rx)

### DIGITAL DUPLEX TEST (Tx)

You can select the DIGITAL DUPLEX TEST (Rx) or DIGITAL DUPLEX TEST (Tx) screens using the soft keys at the bottom of the screen. These provide access to additional functions, as explained in the following subsections.

The generator frequency and level (GEN FREQ, LEVEL), and the test set receiver frequency (Tx FREQ), are inherited from the Systems configuration on entry to Digital DUPLEX TEST mode.

You can set these values at will, using the [Tx], [RF GEN], [FREQ], and [LEVEL] keys, to any value permitted by the test set's normal operating range. As well as entering discrete values via the data keys, you can also use the VARIABLE control or INC (incremental) keys in the usual way. This applies to any of the DIGITAL DUPLEX TEST screens on which these parameters are displayed. The increment values can only be set from the DIGITAL DUPLEX TEST (Rx) or DIGITAL DUPLEX TEST (Tx) screens, but once set can be used in any DIGITAL DUPLEX TEST screen showing  $\Delta$  or  $\delta$ .

## Highlighted measurements

Certain measurements may be highlighted in inverse video, as already explained for Manual testing - for details, refer to page 2-7.

**DIGITAL DUPLEX TEST (Rx) screen**

You can use any one of the three [*duplex test (Rx)*] soft keys at the bottom of the DIGITAL DUPLEX TEST screen to select the DIGITAL DUPLEX TEST (Rx) screen, shown in Fig. 2-12. From the Tx screen, press the [*duplex Rx Tx*] soft key.

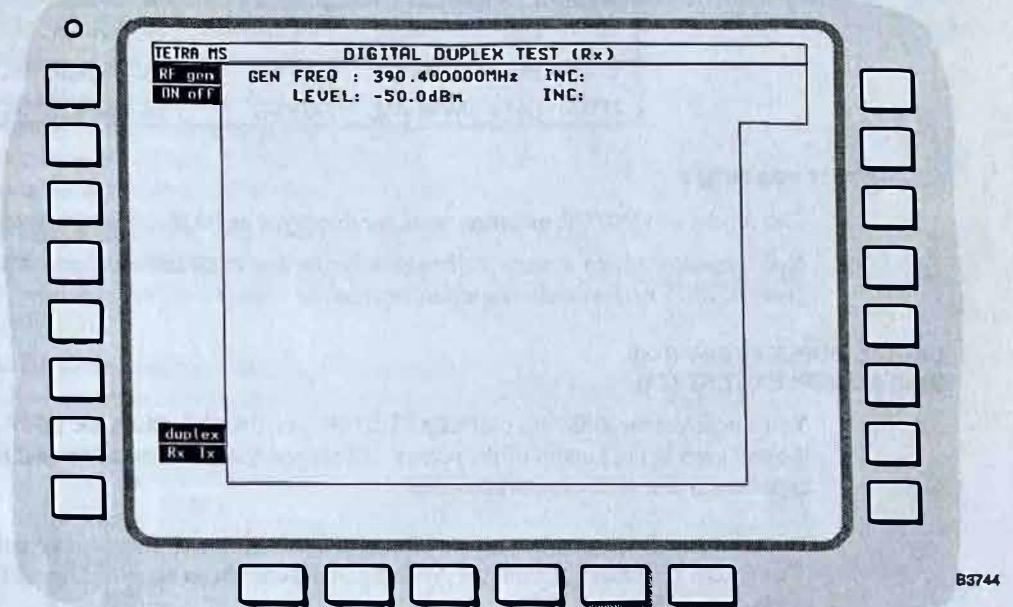


Fig. 2-12 Digital duplex test (Rx) screen.

RF generator frequency and level increments can be set on this screen and will carry over to the top level Digital DUPLEX TEST mode.

**DIGITAL DUPLEX TEST (Tx) screen**

To access the DIGITAL DUPLEX TEST (Tx) screen, shown in Fig. 2-13, from the DIGITAL DUPLEX TEST (top level) screen, you can use any one of the three [*duplex test (Tx)*] soft keys at the bottom of the screen. To access it from the Rx screen, press the [*duplex Rx Tx*] soft key. This screen provides access to measurement bar charts, spectrum analyzer, power analyzer, and vector diagram displays.

To return to the top level screen, press [DUPLEX TEST]. When returning from Systems mode, pressing [DUPLEX TEST] will take you back to the last-used DIGITAL DUPLEX TEST screen.

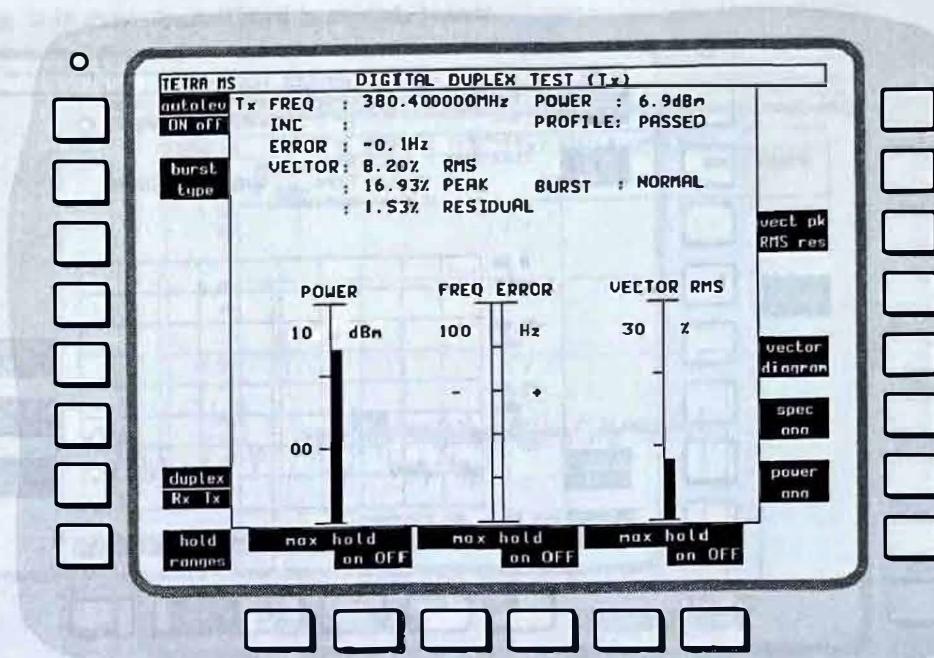


Fig. 2-13 Digital duplex test (Tx) screen.

### Bar charts

Bar charts on the Tx screen give trend indications for power, frequency error, and vector error measurements. The [vect pk RMS res] soft key selects the RMS or peak vector error bar chart or the residual carrier power bar chart. The bar charts have a **max hold** facility controlled via the [**max hold**] soft keys at the bottom of the screen. When the **max hold** is active on a particular bar chart, the corresponding digital readout is also in **max hold**. See Maximum hold in Chapter 3 of the operating manual 468820247T.

### Spectrum analyzer

The [**spec ana**] soft key selects the spectrum analyzer (Fig. 2-14 on page 2-20).

The intermittent appearance of the RF signal on the display is the result of the TDMA operation during the spectrum analyzer sweep. The use of the **max hold** function described below will allow a contiguous display to be produced.

Selecting the expanded (full screen) spectrum analyzer (by pressing the [**expand on OFF**] soft key) gives you access to the **max hold** function. Pressing the [**maxhold on OFF**] soft key captures the peak spectrum during active transmissions. This builds up during a number of sweeps to give a continuous display. Markers, together with the other controls, can be used in the same way as for the standard spectrum analyzer; see the Operating Manual if you need more information.

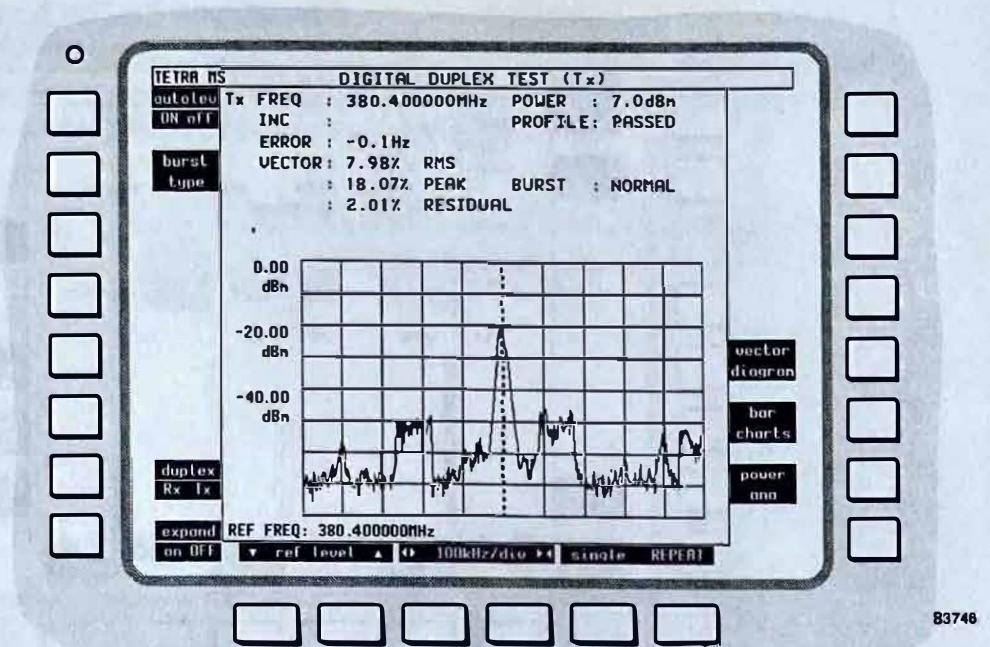


Fig. 2-14 Spectrum analyzer.

### Power analyzer

Use the [power ana] soft key to select the power analyzer (Fig. 2-15). Two additional soft keys appear; [full burst] and [ramps].

Selecting [full burst] displays the entire burst profile including the rising and falling edges (Fig. 2-15). The vertical resolution can be set to 3 dB/division or 10 dB/division.

To avoid large variations due to modulation, the full burst and the ramp displays show power only at the symbol points.

Note that all the power analyzer examples in this chapter are for normal bursts.

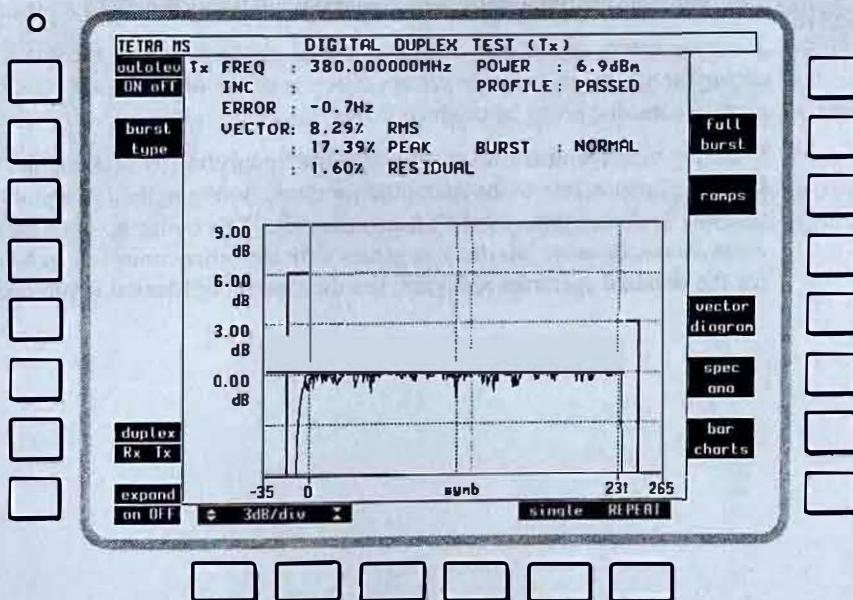
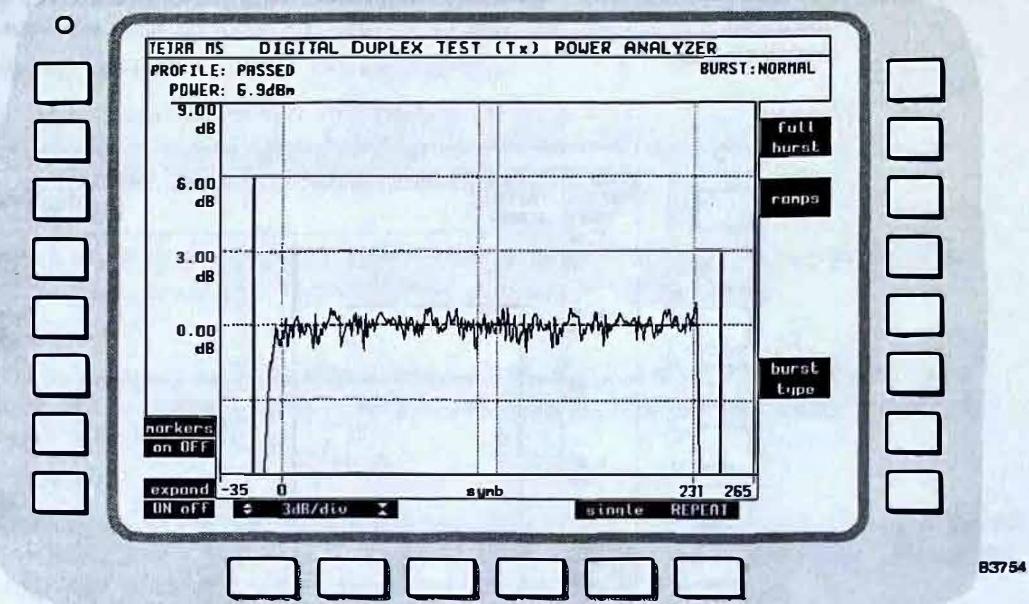


Fig. 2-15 Power analyzer (full burst).

Fig. 2-16 shows the full burst in expanded mode.

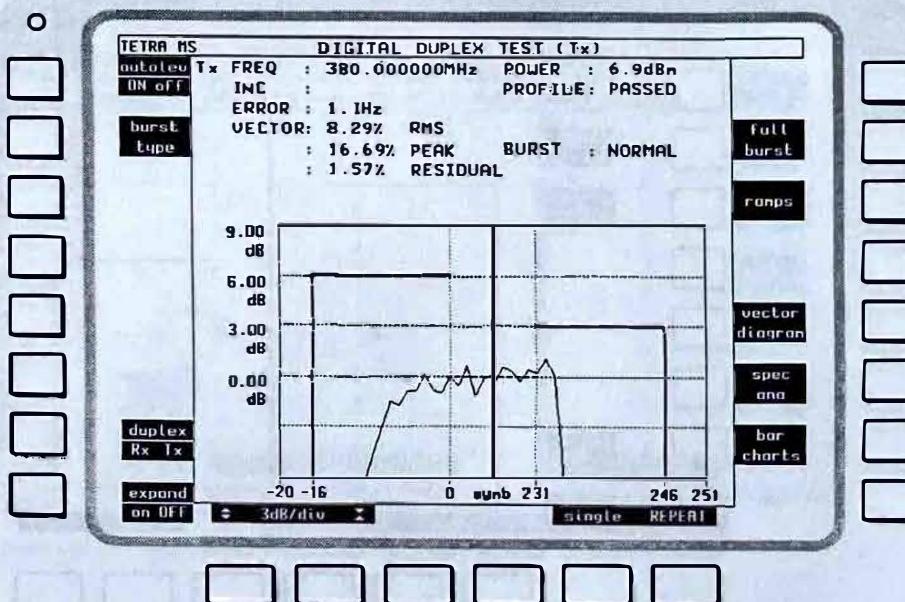


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Fig. 2-16 Power analyzer (full burst) - expanded.

Selecting [ramps] displays only the rising and falling edges of the burst, with greater horizontal resolution than in the full burst display.

The vertical resolution can be set to 3 dB/division or 10 dB/division.



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Fig. 2-17 Power analyzer (ramps).

The [expand on OFF] soft key provides access to a full screen display (Fig. 2-18 on page 2-22).

## OPERATION

The condition of the displayed burst is shown as PASSED or FAILED against the PROFILE indicator at the top left of the display. Below this the POWER indicator shows the RF level.

Markers can be selected, with the readings from them shown at the top of the display (Fig. 2-19). Intelligent markers accommodate the missing section of the burst when performing 'delta marker' measurements.

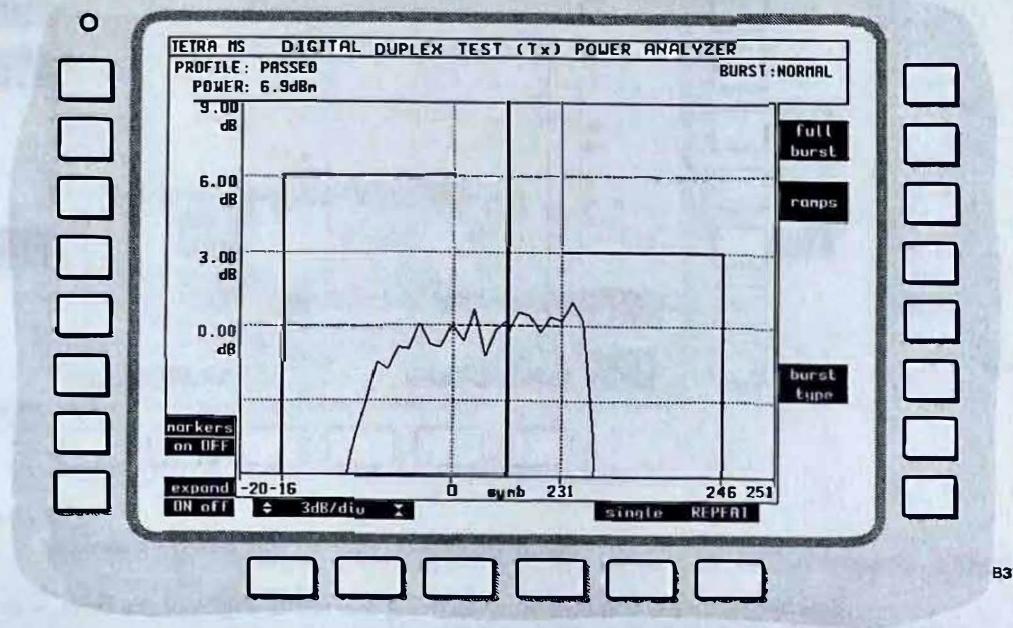


Fig. 2-18 Power analyzer (ramps) - expanded.

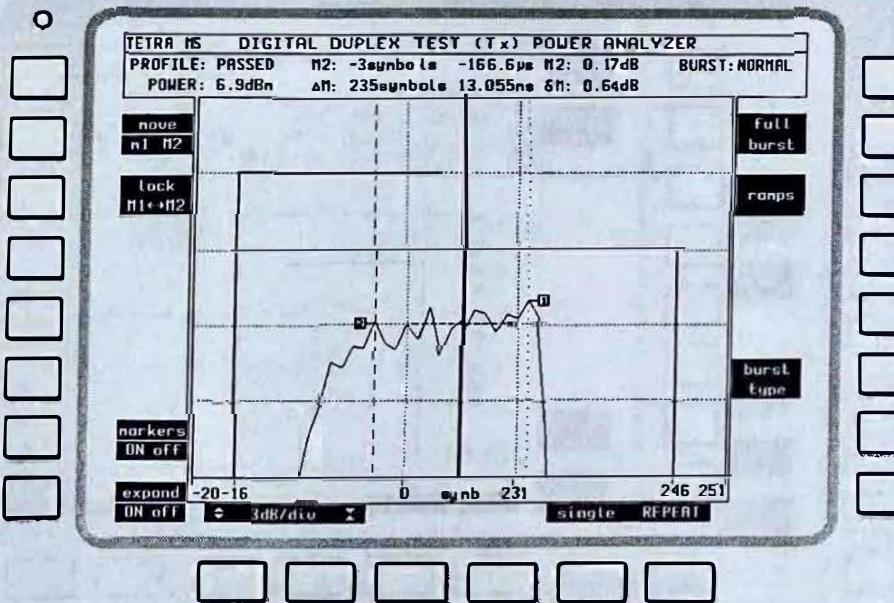


Fig. 2-19 Power analyzer (ramps) - expanded with markers.

## Vector diagrams

The vector diagram function is able to show modulation errors in graphic form. Measurements relating to the displayed data are shown on the display. Three aspects of the modulation are provided:-

Symbol constellation, normal or expanded display.

Phase trajectory, normal or expanded display.

Rotated vector, normal or expanded display.

## Display updating

At the bottom left of the display are soft keys which allow you to select the way in which the vector diagrams are updated. The selected key is shown in UPPER CASE.

### [REFRESH]

Pressing this key sets the *REFRESH* display option. As each burst of the selected type is received, the display relating to the previous burst is erased and that relating to the current burst is displayed.

### [PERSIST]

Pressing this key sets the *PERSISTENCE* display option. A vector display relating to several previous bursts is displayed. As each burst of the selected type is received, the data is added to the display but that of the earliest of the previous bursts is erased.

### [ACCUM]

Pressing this key sets the *ACCUMULATE* display option. As each burst of the selected type is received, the data is added to the vector display.

## Symbol constellation

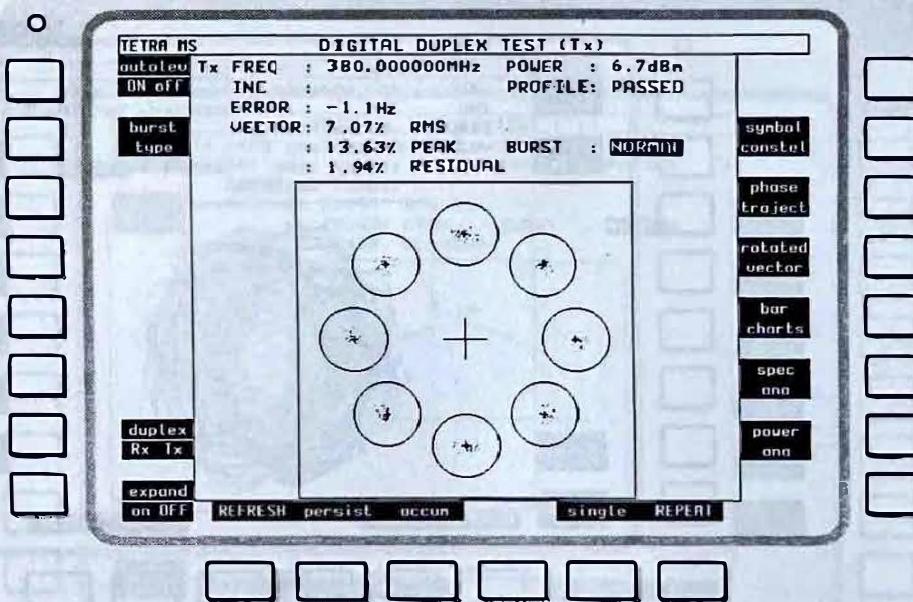
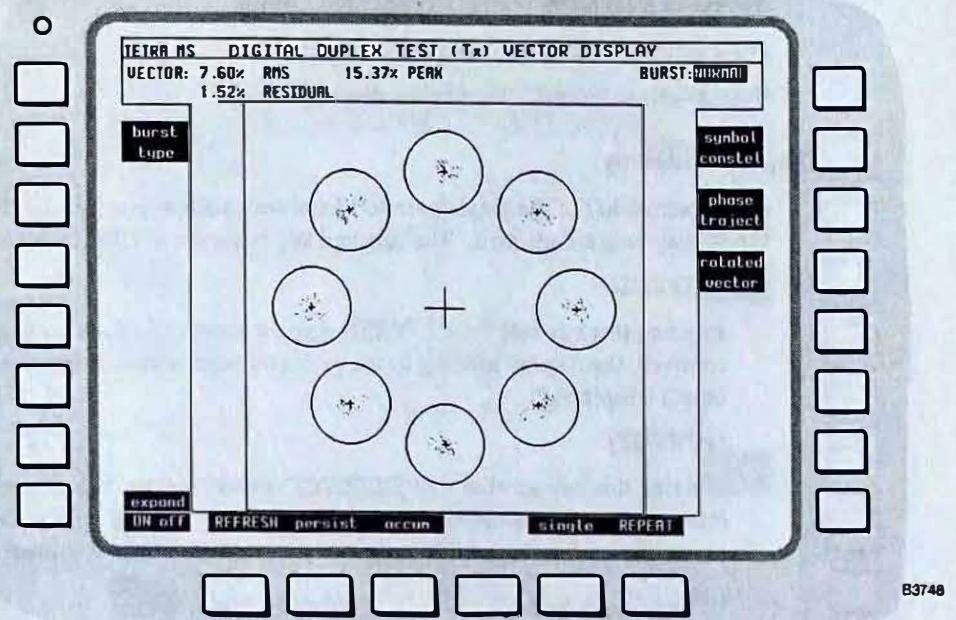


Fig. 2-20 TETRA symbol constellation vector diagram.

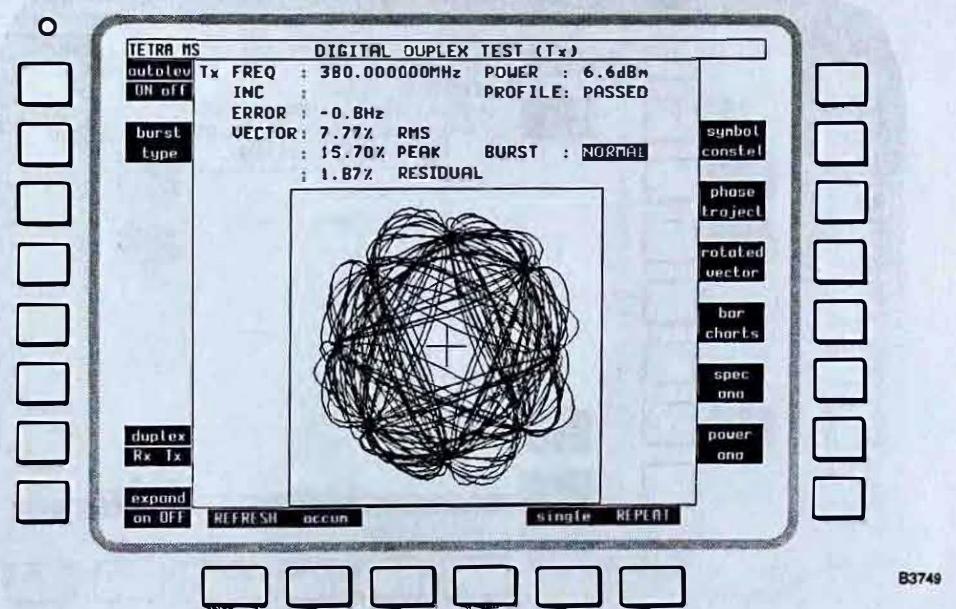
The symbol constellation display shows the modulation at the symbol points. The normal display, shown in Fig. 2-20, includes vector measurement results of % RMS, % PEAK and % RESIDUAL. Transmission measurement results are also included.

**Expanded display**

Selecting the expanded display increases the area of the symbol constellation display but removes some readings and keys. The selected burst type is indicated and readings of vector % RMS and % peak remain.



*Fig. 2-21 TETRA symbol constellation vector diagram (expanded).*

**Phase trajectory**

*Fig. 2-22 TETRA phase trajectory vector diagram.*

The phase trajectory vector diagram shows the modulation at the symbol points and the transition between points (path trajectory). The normal display, shown in Fig. 2-22, includes vector measurement results of % RMS, % PEAK and % RESIDUAL. Transmission measurement results are also included.

### Expanded display

Selecting the expanded display increases the area of the phase trajectory display but removes some readings and keys. The selected burst type is indicated and readings of vector % RMS and % peak remain.

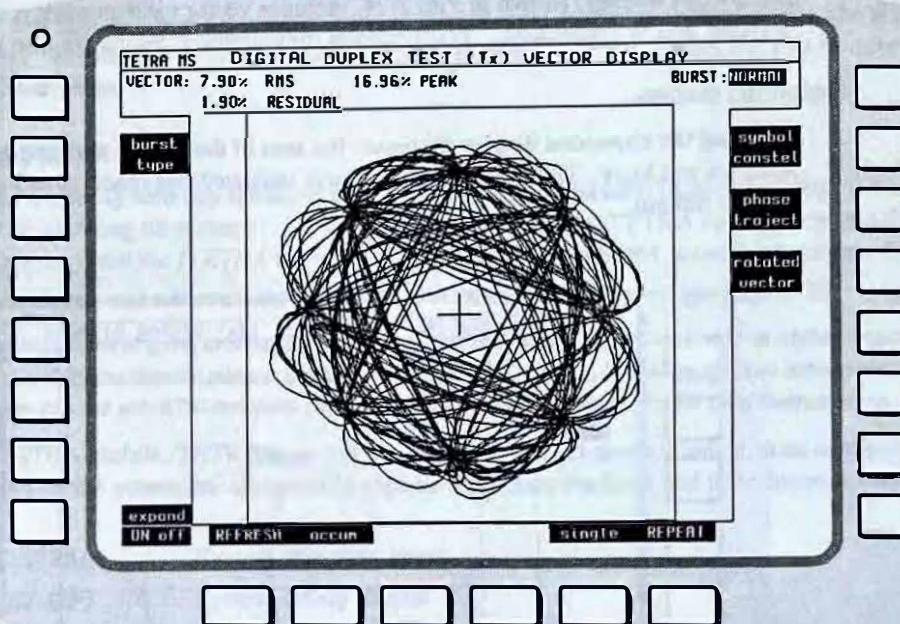


Fig. 2-23 TETRA phase trajectory vector diagram (expanded).

### Rotated vector

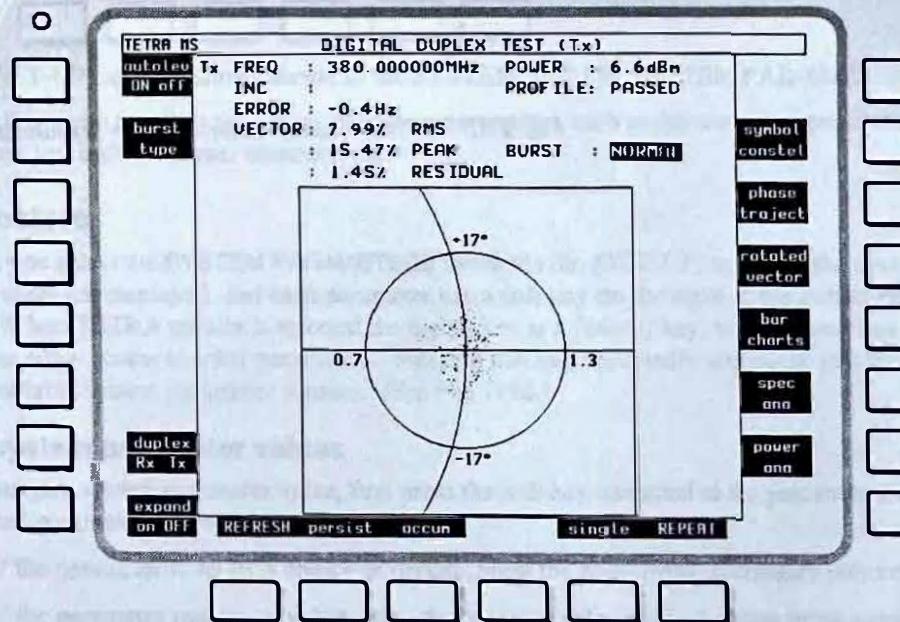


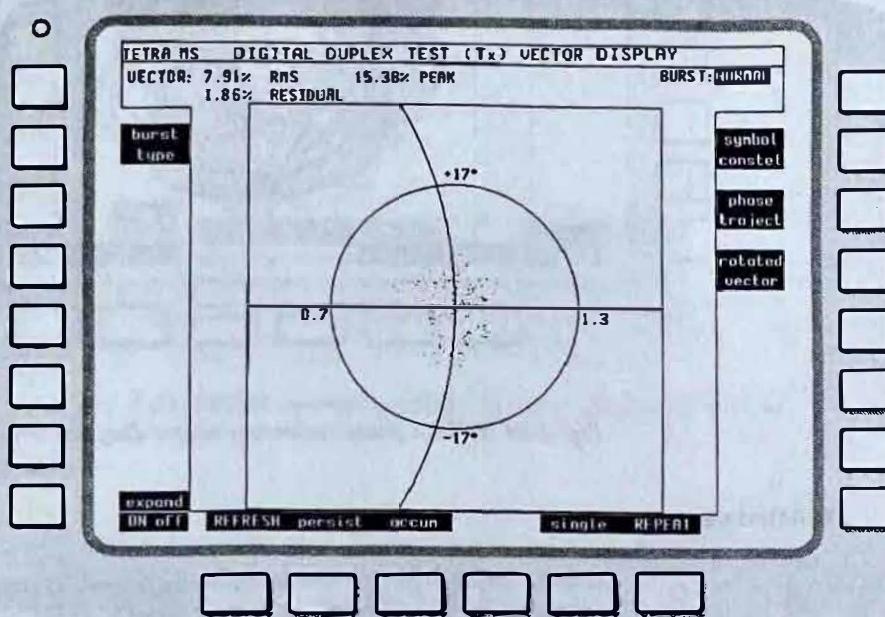
Fig. 2-24 TETRA rotated vector diagram.

The rotated vector diagram shows all eight constellation diagram symbol points together on a single point. The display is obtained by rotating all points, other than the EAST point, about the common axis until they are superimposed on the EAST point. The display then shows positive phase errors upward, negative phase errors downward, negative magnitude errors to the left and positive magnitude errors to the right.

The normal display, shown in Fig. 2-24, includes vector measurement results of % RMS, % PEAK and % RESIDUAL. Transmission measurement results are also included.

#### Expanded display

Selecting the expanded display increases the area of the rotated vector display but removes some readings and keys. The selected burst type is indicated and readings of vector % RMS and % peak remain.



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Fig. 2-25 TETRA rotated vector diagram (expanded).

## Customising the system

Before you use the test set for manual testing, you may need to customise the system by changing some of the default test parameters. You can do this via the [SYSTEMS] hard key and [SYSTEM] and [SET-UP] soft keys, as explained in this section.

### Note

If you attempt to enter a parameter value that is outside the permitted limits, the screen message **Entered value is out of range** appears and the test set waits for you to enter a permitted value.

## Selecting the system

The [SYSTEMS] hard key initially<sup>2</sup> displays the SYSTEM SELECTION menu (Fig. 2-1 on page 2-4) showing all systems. To select the TETRA mobile, TETRA base station or TETRA direct mode, press the [*TETRA mobile*], [*TETRA base*] or [*TETRA direct*] soft key on this menu. If required, you can select a user-defined variant of the system type - see page 2-29

**Note:** At the time of going to press, the mapping of *Channel Numbers to Frequency* has not been decided by ETSI. Therefore the channel plans in the Test Set are presumed and may change in future software issues, to bring them into line with ETSI decisions. Where inconsistencies are found, use the *User Defined* plans.

With TETRA mobile, TETRA base station or TETRA direct mode selected, four of the soft keys at the left of the screen are allocated to explicit functions; the keys and their functions are shown below.

[SYSTEM]	System selection menu
[SET-UP]	System set-up menus
[MANUAL]	Manual test mode
[DATA]	Data display

### [SYSTEM]

The [SYSTEM] soft key, which is always visible in Systems mode, takes you to the SYSTEM SELECTION menu, allowing access to all of the test systems that are installed in the test set and an option [*no system*] to disable the active system prior to leaving the Systems mode.

### [SET-UP]

The [SET-UP] soft key allows access to the SYSTEM SET-UP SYSTEM PARAMETERS menu. This allows you to adjust the values of system parameters such as the control channel number, first and last traffic channel numbers, etc.

## System parameters

When you select the SYSTEM PARAMETERS menu via the [SET-UP] soft key, the system parameters are displayed, and each parameter has a soft key on the right of the screen dedicated to it. When TETRA mobile is selected the eighth key is a [*more*] key, which re-assigns the soft keys to allow access to other parameters. Pressing this key repeatedly will cycle you through all the available system parameter screens. (See Fig. 2-26.)

## Changing system parameter values

To change a system parameter value, first press the soft key assigned to the parameter; the selected parameter will be highlighted. Then:-

- If the parameter is set by a choice of options press the appropriate secondary soft key.
- If the parameter requires a value, enter the required value using the data input keys and then press any of the ENTER data keys or the selected parameter soft key.

<sup>2</sup> The first time that the [SYSTEMS] key is pressed after switch-on. Otherwise the latest Systems screen appears. If a digital System was selected previously, an initialization process will run for a few seconds.

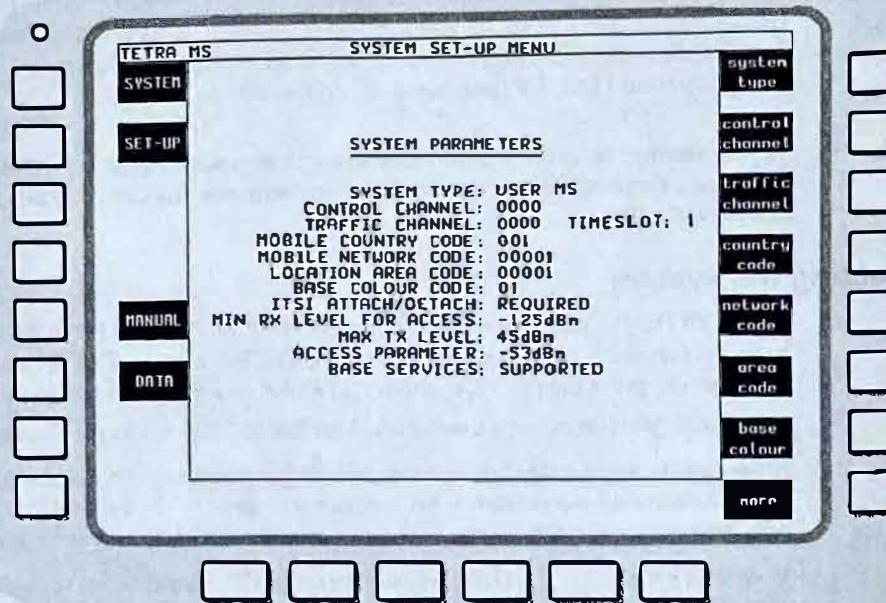


Fig. 2-26 System parameters menu TETRA MS.

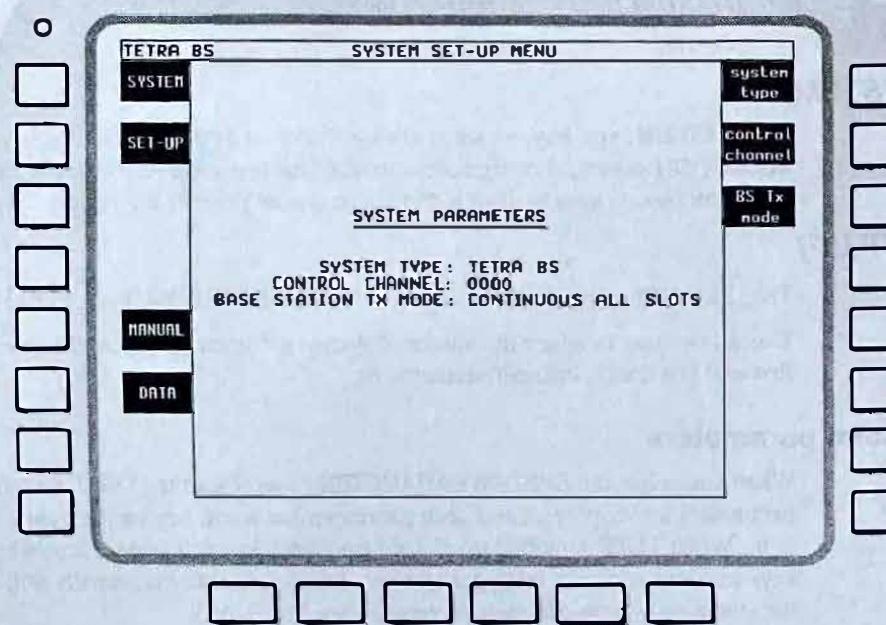
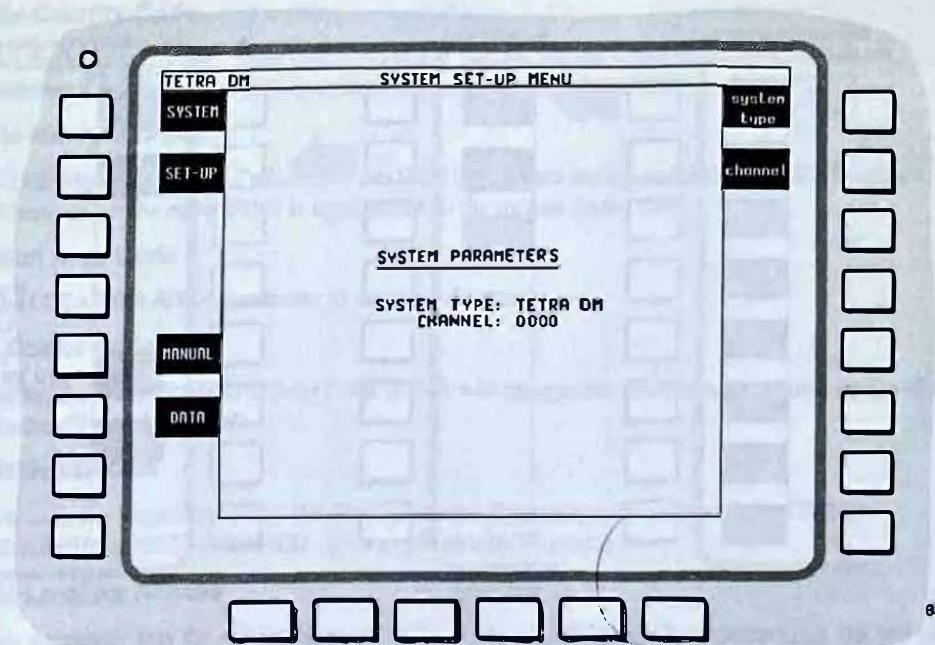


Fig. 2-27 System parameters menu TETRA BS.



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*Fig. 2-28 System parameters menu TETRA DM.*

The system parameters that you can modify are described below. Default values are shown in Chapter 1, *General Information*, under the heading *Test parameters*.

The parameters are different for each of the TETRA systems, therefore those for TETRA MOBILE are described first followed by those for TETRA BASE STATION, then those for TETRA DIRECT MODE

## TETRA MOBILE parameters

### System Type

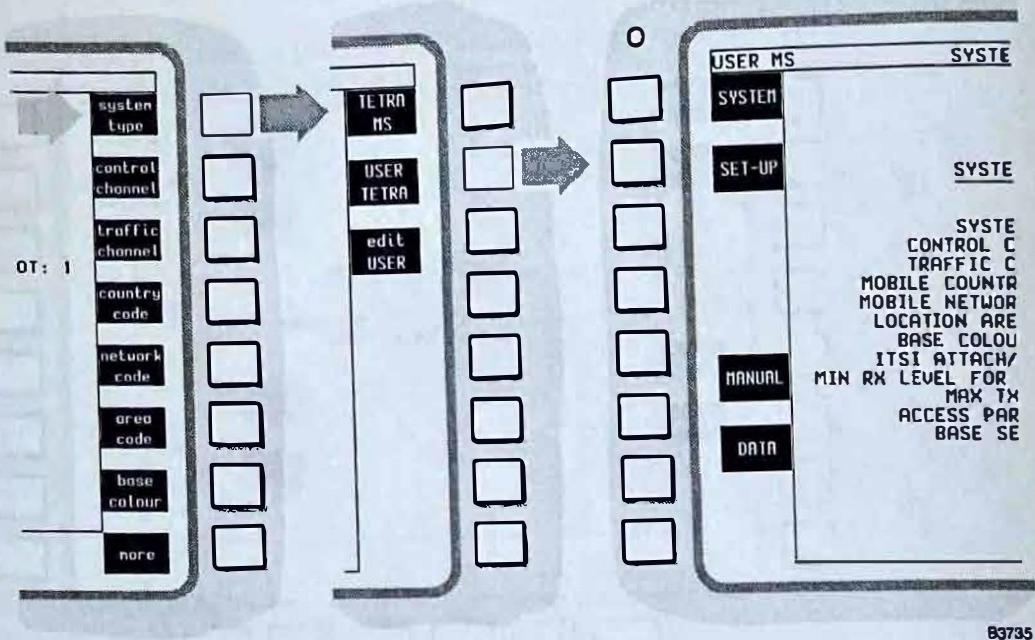
The current system type is shown at the top left of the screen. You can change to a user-defined variant.

**Note:** You may find that it is necessary to use USER TETRA, as at the time of Phase 1 release there were no agreed definitions for TETRA channel numbers.

The selection procedure is as follows; press:-

1. [system type] on the SYSTEM PARAMETERS menu.
2. (a) For TETRA Mobile (MS): [TETRA MS] or [USER TETRA] secondary soft key (see Fig. 2-29).
- (b) For TETRA Base (BS): [TETRA BS] or [USER TETRA] secondary soft key
- (c) For TETRA Direct Mode (DM): [TETRA DM] or [USER TETRA] secondary soft key.

As indicated above, you can set up parameters for your own system types, which will be available through the [USER TETRA] key. Pressing the [edit USER] soft key gives you access to the EDIT USER menu, which allows you to enter the appropriate channel block parameters. For further information see *Setting up a user-defined system type* starting on page 2-32.



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Fig. 2-29 System type selection for TETRA Mobile (MS).

**Note**

The Control Channel and Traffic Channel parameters are mainly used in automatic tests. This facility will be provided in a later phase of the TETRA Systems test software. However, the Control Channel and Traffic Channel power-on values also determine the initial Control Channel and Traffic Channel values (page 2-14) for Manual testing.

**Control Channel**

The Control Channel parameter on the SYSTEM PARAMETERS menu can be set to any value within the range permitted by the selected system type (see the appropriate *Performance Data* section in Chapter 1). The test set prevents you entering a value outside this range. If you want to change the control channel default value, you can enter the required channel number using the data keys. The timeslot for the control channel is always TN 1.

**Traffic Channel**

This parameter specifies the initial channel number for the TCH generator in the manual testing mode. Pressing the [*traffic channel*] soft key twice highlights the TIMESLOT legend. (See below.)

**Time slot**

This parameter specifies the initial timeslot for the TCH generator in the manual testing mode. To change the Timeslot value, press the [*traffic channel*] soft key twice.

**Note**

You can set any or all of the remaining system parameters, MCC, MNC, LAC or BCC, to match a real Base Station.

**Note**

The scrambling sequence used by the test set is produced from the Mobile Country Code, the Mobile Network Code and the Base Colour Code. If the mobile under test is in a test mode where it expects a certain fixed value of scrambling sequence, the MCC, MNC and BCC must be set to produce the scrambling sequence expected.

BCC, MCC and MNC are all parameters on the Broadcast Synchronisation Channel (BSCH) which is sent in MCCH, TCH and T1 signals. Changing any of these will change the Scrambling sequence which applies to all signals (MCCH, TCH and T1) generated and received by the Test Set. This does not apply to the BSCH itself, which substitute zero values for BCC, MCC and MNC when generating the Scrambling sequence.

**Mobile Country Code**

Set the Mobile Country Code (MCC) to 001 if you are testing a mobile using RF loopback.  
Otherwise set the code which is appropriate to the mobile under test.

**Mobile Network Code**

Set the Mobile Network Code (MNC) to 00001 if you are testing a mobile using RF loopback.  
Otherwise set the code which is appropriate to the mobile under test.

**Location Area Code**

The LOCATION AREA parameter in system information.

**Base Colour Code**

Setting the Base (Station) Colour Code (BCC) will change the scrambling sequence on the Main Control Channel (MCCH).

**ITSI Attach/Detach**

Sets both the Registration and the De-registration flags in system information to either REQUIRED or NOT REQUIRED. (Not applicable to T1 mode)

**Min Rx Level for Access**

This parameter sets the minimum received level of a signal from a Base Station (i.e. the test set in this instance) that the mobile is permitted to accept. (RXLEV\_ACCESS\_MIN parameter in system information.) The range is from -125 dBm to -50 dBm, in 5 dBm steps.

**Max Tx Level**

This parameter sets the maximum power level step at which a mobile is permitted to transmit. (MS\_TXPWR\_MAX\_CELL parameter in system information.) The range is PL1 (45 dBm) to PL7 (15 dBm).

**Access Parameter**

This sets the ACCESS\_PARAMETER value in system information, which controls MS Link Control Operation. The range is from -53 dBm to -23 dBm.

**Base Services**

This sets all of the following system information parameters to SUPPORTED or NOT SUPPORTED:-

Migration; Roaming; Voice Services; Circuit Mode Data; CONP Packet Data; SCLNP Packet Data

Phase 1 release does not support any of these services, but setting to SUPPORTED will permit the a Mobile Under Test to make attempts (Control Bursts) to use these. The method of controlling these parameters may not necessarily be by this method in future phases.

**TETRA BASE STATION parameters****System Type**

See System Type under **TETRA MOBILE parameters** above.

**Control Channel**

Here you set the frequency on which the Test Set will receive the Base Station transmissions.

**Base Station Tx Mode**

Allows you to set the Test Set to receive CONTINUOUS transmission (All slots) or DISCONTINUOUS transmissions (Not all slots).

## TETRA DIRECT MODE parameters

### System Type

See System Type under TETRA MOBILE parameters above.

### Channel

Here you set the frequency on which the Test Set will receive the Direct Mode transmissions from the Mobile Under Test.

## Setting up a user-defined system type

If you want to set up your own system type with specific system parameters (or modify a previously defined user type), you can do this as follows:-

1. Change the system type to USER MS, USER BS or USER DM by pressing the [system type] soft key on the SYSTEM PARAMETERS menu and then pressing the secondary soft key [/USER TETRA J]. This gives you access to the USER MS, USER BS or USER DM system parameters menu. Fig. 2-29 shows the menu structure for TETRA MS; the structure is similar for TETRA BS and TETRA DM.
2. Set up the USER MS, USER BS or USER DM system parameters as required (see the section *System parameters* on page 2-27 if you need information on this).

If you want to set up a special frequency plan using channel blocks:-

**Note:** At the time of going to press, the mapping of Channel Numbers to Frequency has not been decided by ETSI. Therefore the channel plans in the Test Set are presumed and may change in future software issues, to bring them into line with ETSI decisions. Where inconsistencies are found, use the User Defined plans.

3. Press [system type] on the SYSTEM PARAMETERS menu followed by the secondary soft key [/edit USER] to bring up the EDIT USER menu (Fig. 2-30 on page 2-32).
4. Set up the required channel block(s) as explained on page 2-33.

Once set up, this user-defined system will be available for future use via the relevant [/USER TETRA J] key.

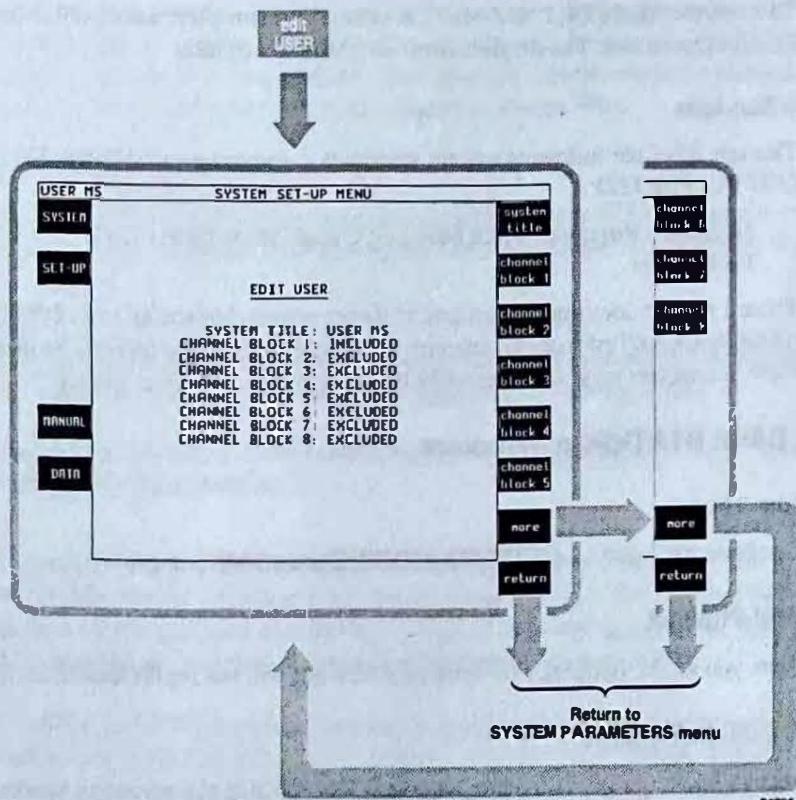


Fig. 2-30 Editing a user-defined system

The parameters on the EDIT USER menu are described below.

### System Title

The user defined system can be given any title of up to 10 characters.

To change the system title, first press the [system title] key. A screen similar to that shown in Fig. 2-31 will be displayed. The legend **SYSTEM TITLE** will be highlighted and an inverse video cursor will be present on the list of characters at the bottom of the screen.

Use the rotary control to place the cursor over the character to be the first character in the new title. Press the [enter char] key. The selected character will replace the previous title. Use the rotary control and [enter char] key to complete the title. The [delete char] key removes the latest character entered in the title. When the title is complete press the [title complet] key. The EDIT USER screen will be displayed with the new title shown against the SYSTEM TITLE: legend.

The new system title will be shown at the top left of the display after you exit EDIT USER or after you press the [return] key.

The **USER TETRA** text on the soft key for access to the USER SYSTEM type will not change.

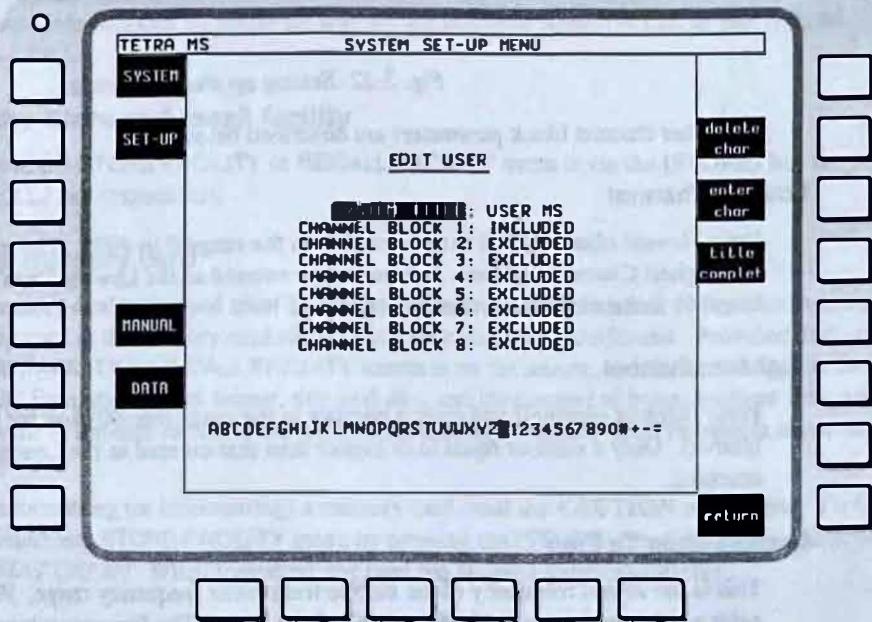


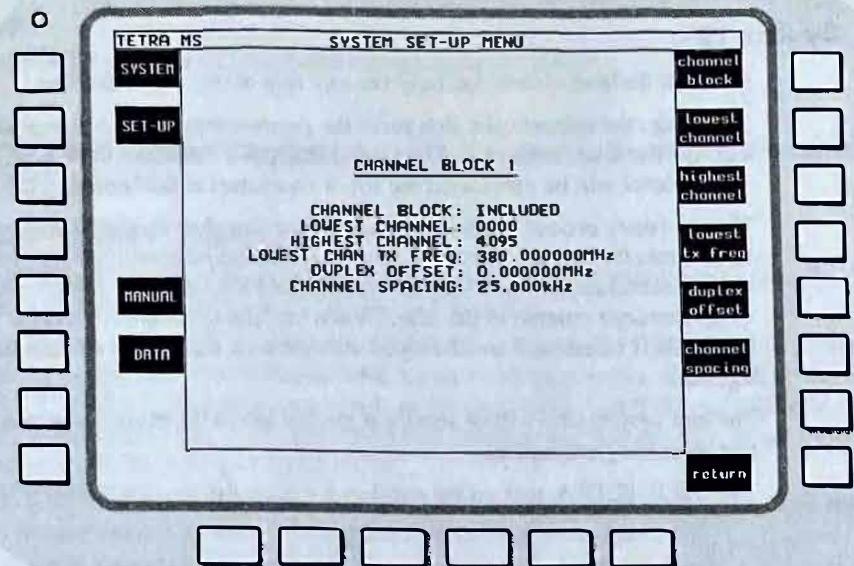
Fig. 2-31 **USER SYSTEM TITLE** editing screen.

### Channel Blocks 1 to 8

The allocation of frequencies is not necessarily in continuous frequency bands. To make the maximum use of allocated frequencies, some frequency plans may be complex. Also, the duplex offset and channel spacing can be different for different channels within the same system. To enable the testing of mobiles or base stations programmed with such complex frequency plans, the test set has 8 channel blocks, each of which can hold a simple channel plan together with the appropriate duplex offset and channel spacing.

### Channel Block

Each channel block can be included or excluded in the frequency plan. Select the appropriate channel block by pressing one of the soft keys [*channel block 1*] to [*channel block 8*] (Fig. 2-30), followed by the [*channel block*] soft key (Fig. 2-32 on page 2-34). Then press the secondary soft key [*include*] or [*exclude*] as required.



*Fig. 2-32 Setting up channel blocks.*

The other channel block parameters are described below.

#### Lowest Channel

Press [*lowest channel*] and enter a number in the range 0 to 4095. The number must not exceed the Highest Channel number. The frequency entered as the Lowest ChanTx Freq (see below) will be given to the channel number entered here.

#### Highest Channel

Press [*highest channel*] and enter a number in the range 0 to 4095 as for the Lowest Channel (above). Only a number equal to or higher than that entered as the Lowest Channel will be accepted.

#### Lowest Chan Tx Freq

This is the lowest frequency of the mobile transmitter frequency range. Press [*lowest tx freq*] and enter a value in the range 10 MHz to 999.9999 MHz. The frequency entered here is the frequency used by the channel number set as the *Lowest Channel* (see above). e.g. If the *Lowest Channel* is set as 101 and the *Lowest Chan Tx Freq* is set as 380.025 MHz, then channel 101 will set 380.025 MHz, channel 102 will set 380.050 MHz and channel 100 cannot be selected.

#### Duplex Offset

Press [*duplex offset*] and enter a value in the range 0 to 100 MHz.

In USER MS:-

Mobile receiver frequency = mobile transmitter frequency + duplex offset.

In USER BS:-

Base station transmitter frequency = base station receiver frequency + duplex offset.

#### Channel Spacing

Press [*channel spacing*] and enter a value in the range 5 kHz to 500 kHz. The system rounds to the nearest 50 Hz. Negative values may be entered for systems where the frequency of channel 1 is higher than that of the maximum channel number.

## Store and recall facility

### Introduction

You can store instrument settings internally within the test set. Instrument settings, instrument results and systems settings can be stored externally on a memory card inserted in the memory card slot. A block diagram of the Store and recall facility is shown in Fig. 2-33 on page 2-36.

This section describes how to store and recall systems settings. The main Operating Manual has a section explaining the use of this facility to store instrument settings and results.

### Systems settings

When you store systems settings, the information relating to every system available on the particular instrument is stored.

Therefore, although Phase One of the TETRA System does not include test options included on some other test systems, the information on the SYSTEM PARAMETERS, MOBILE PARAMETERS, AUTORUN CONTROL and AUTORUN PARAMETERS menus as applicable for *all* systems, not just the currently selected system, are stored.

### Suitable memory cards

Memory cards, suitable for use in the test set, are available from IFR Ltd. as part number 59000-189M.

### Accessing the Store and recall facility

Access to the STORE FACILITY or RECALL FACILITY menu is via the [STORE] key or [RECALL] key respectively.

### Formatting a memory card

The memory card to be used must be formatted for use with the test set. When you insert a memory card in the memory card slot, the test set checks the card format. Provided that one of the STORE FACILITY or RECALL FACILITY menus is on the screen, and the card format is correct (i.e. MI DOS Format), the card format, title and size, and the number of bytes used and free, are displayed. If the card format is not correct, the message **Memory Card Format is Incorrect** is displayed.

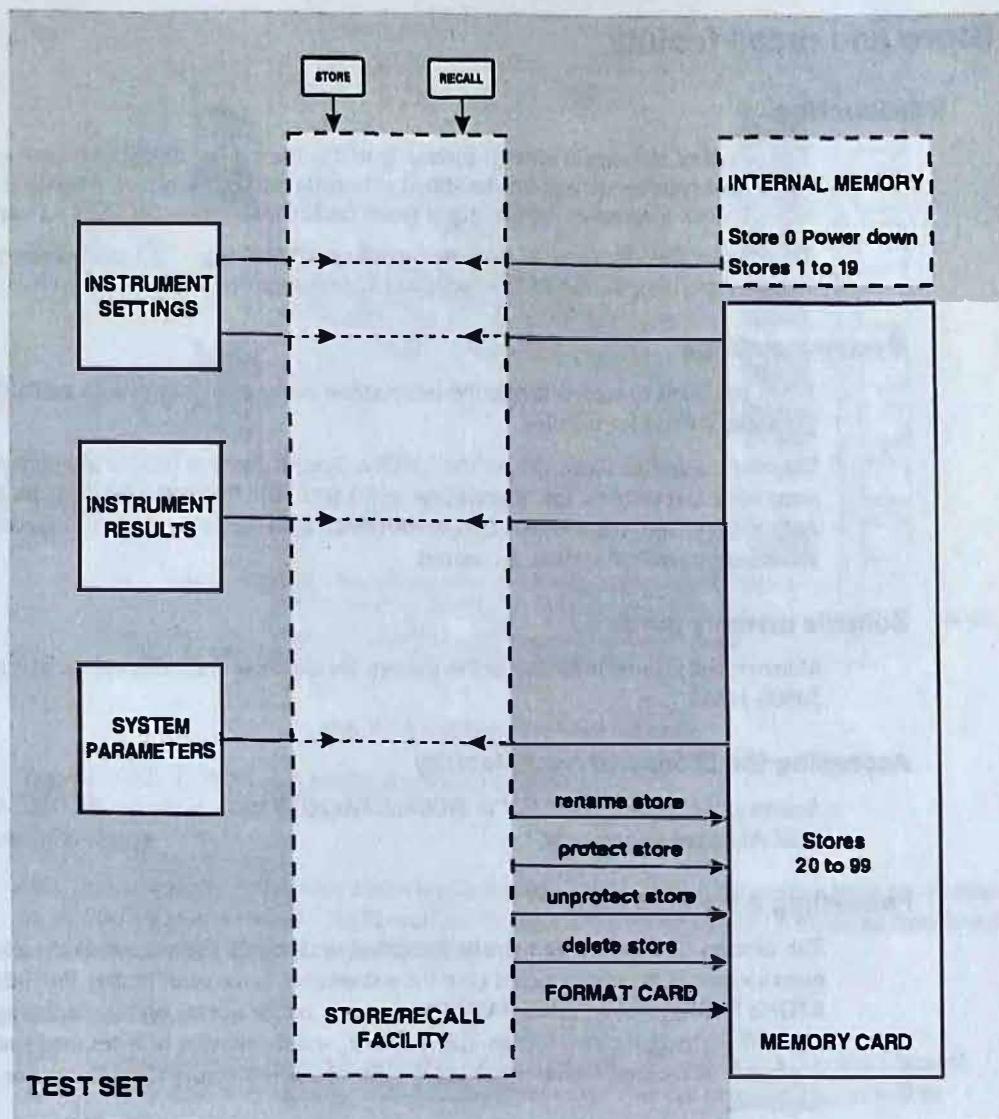
Before formatting (or reformatting) a memory card, read the CAUTION note below. To format a card, select any STORE FACILITY menu by pressing the [STORE] function key, and then press [*FORMAT CARD*]. When formatted, the card has 80 store locations (20-99).

#### CAUTION

Formatting a memory card results in the loss of all data previously stored on the card. Memory cards should not be subjected to extremes of temperature.

### Protection

You can prevent the unintentional deletion or overwriting of a specific store location on a memory card by protecting it; see page 2-39. However, there is no protection against formatting, other than the physical *Read Only* switch on the card. See the CAUTION above.



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Fig. 2-33 Store and recall facility - block diagram

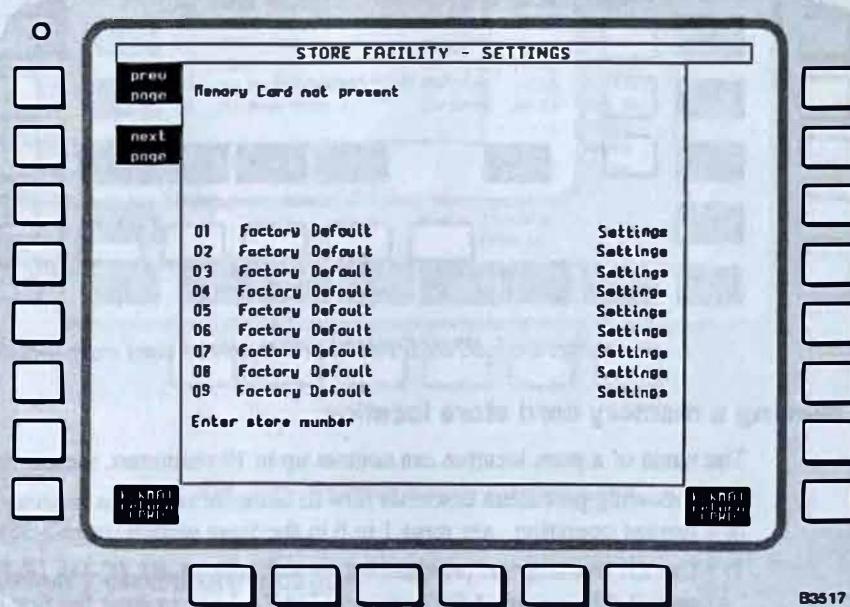
**Store**

To store the systems settings to a memory card:-

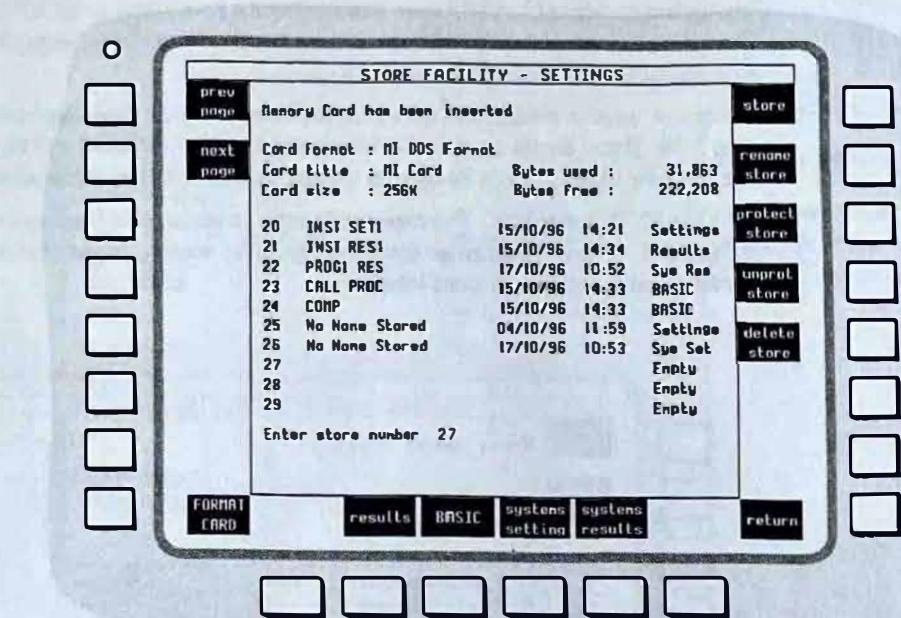
1. Access the store facility by pressing the [STORE] function key. One of the STORE FACILITY menus appears. This will either be the factory default (the STORE FACILITY - SETTINGS menu; see Fig. 2-34) or the STORE FACILITY menu that was last selected in the current test session.
2. Insert a memory card, and format it if necessary (see page 2-35).
3. Use the [*next page*] or [*prev page*] key to display one of the pages showing memory card stores, i.e. stores from 20 to 99. A typical memory card page is shown in Fig. 2-35 on page 2-38. Note that stores 1 to 19 are internal and cannot be used for systems data. Information adjacent to each store number indicates that the store is either empty or, if not, its name, the date and time at which data was stored, and the type of data stored. Store locations can be re-used if their contents are no longer required, and renamed if necessary.
4. Press the [*systems setting*] key to specify the type of data that you want to store. Later phases of the TETRA Systems test software will provide facilities for storing Systems Results, and MI-BASIC Programs.
5. Decide at which store location the data is to be stored and enter the store number using the

appropriate numerical DATA keys. Press either the *[store]* key or the ENTER data key. The screen changes to show soft keys that can be used to enter or change the name of the store location; see Fig. 2-36 on page 2-39.

6. If required, enter or change the store location name using the procedure described on page 2-38. If you do not do this, the default name No Name Stored will be assigned to it. The *{rename store}* key can be used to rename the store location subsequently.
  7. Press the ENTER data key. The message Storing <data type> to Memory Card. Please wait. is displayed. When this message disappears from the screen, the data has been stored on the memory card in the chosen store location.



**Fig. 2-34 STORE FACILITY - SETTINGS menu.**



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Fig. 2-35 STORE FACILITY - memory card store locations 20 to 29.

### Naming a memory card store location

The name of a store location can contain up to 19 characters, including spaces.

The following procedure describes how to name, or rename, a memory card store location as part of a storage operation - see steps 1 to 6 in the *Store* section (page 2-36):-

1. Use the character set provided by the soft keys [A-B], [C-D], [E-F] etc (see Fig. 2-36 on page 2-39), or one of the numerical DATA keys, to enter the first character of the name. To select the alphabetic characters B, D, F, ... to Z, press the associated key twice in quick succession. Similarly, for the remaining two character keys press once or several times in quick succession until the character that you need appears. You can also use the DATA keys to enter the full-stop (.) or dash (-) characters.
2. Enter the next character of the name in the same way.
3. You can delete characters while the naming procedure is active by pressing the [DELETE] data key. The character to the left of the current cursor position will be deleted. Repeated pressing deletes further characters.
4. The functions of the other soft keys are described below. Note that you can use the VARIABLE rotary control to reposition the cursor.
5. When you have set up the required name, press the ENTER data key to complete the storage procedure.

### Other soft key functions

The functions of the soft keys at the bottom of the screen are:-

**{insert/exchange}** Toggles between insert or exchange modes; the current mode is shown on the screen. In insert mode, characters that you enter are *added* to the name at the current cursor position. In exchange mode, characters that you enter *replace* the character at the current cursor position.

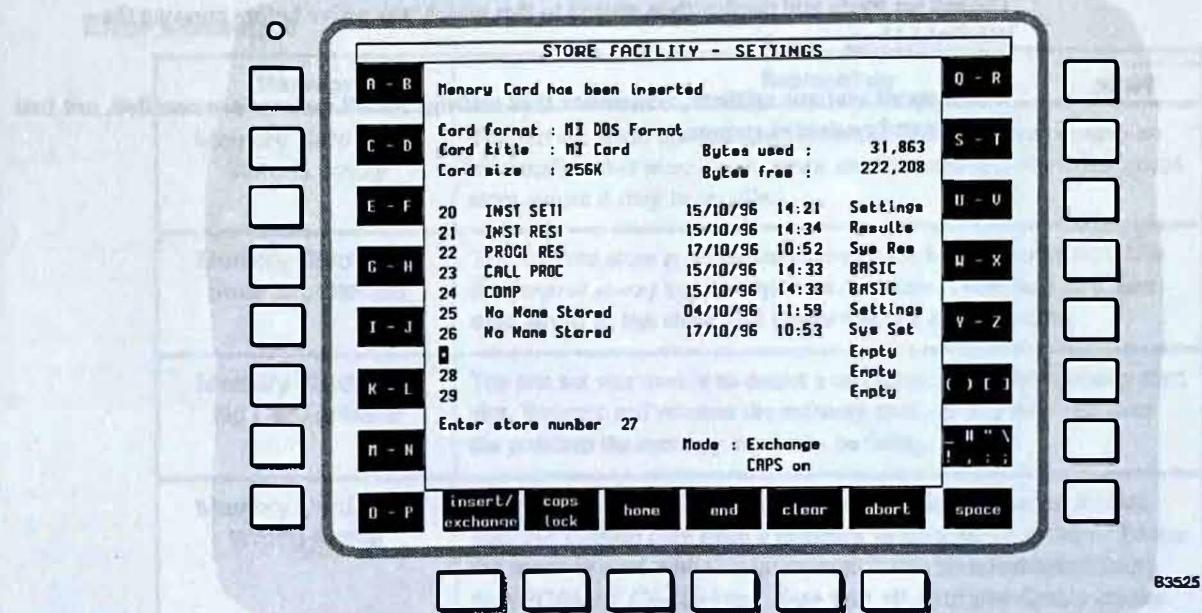
**{caps lock}** Allows you to select uppercase (caps) or lowercase alphabetic characters. In caps mode, the message CAPS ON is displayed.

**{home}** Moves the cursor to the start of the name.

**{end}** Moves the cursor to the end of the name.

[clear] Deletes all characters.

[abort] Aborts the storage operation.



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Fig. 2-36 Entering a store location name.

### Renaming a memory card store location

The storage procedure, as described in the *Store* section (page 2-36), always gives you the option of renaming a store location that has already been used which you want to overwrite. However, you may want simply to change the name of a store location *without* changing its contents.

You can do this by accessing the appropriate STORE FACILITY screen as described previously, entering the store number, and then pressing the [rename store] key. This brings up the naming screen (Fig. 2-36). The procedure is then the same as that described in the section *Naming a memory card store location* (page 2-38).

### Protecting or unprotecting a memory card store location

To protect a memory card store location from accidental erasure, select the store location as described previously, either as part of data storage or as a separate operation, and press the [protect store] key. Each protected store location has the letter P beside the store number. You can remove this protection by selecting the store location and pressing the [unprot store] key.

### Deleting a memory card store location

You can delete the contents of a memory card store location, provided that it is not protected, by selecting it as described previously, either as part of data storage or as a separate operation, and then pressing the [delete store] key. The title and other text beside the store number is replaced by the word Empty.

### Recall

To recall systems settings from a memory card, insert the card and press the [RECALL] function key.

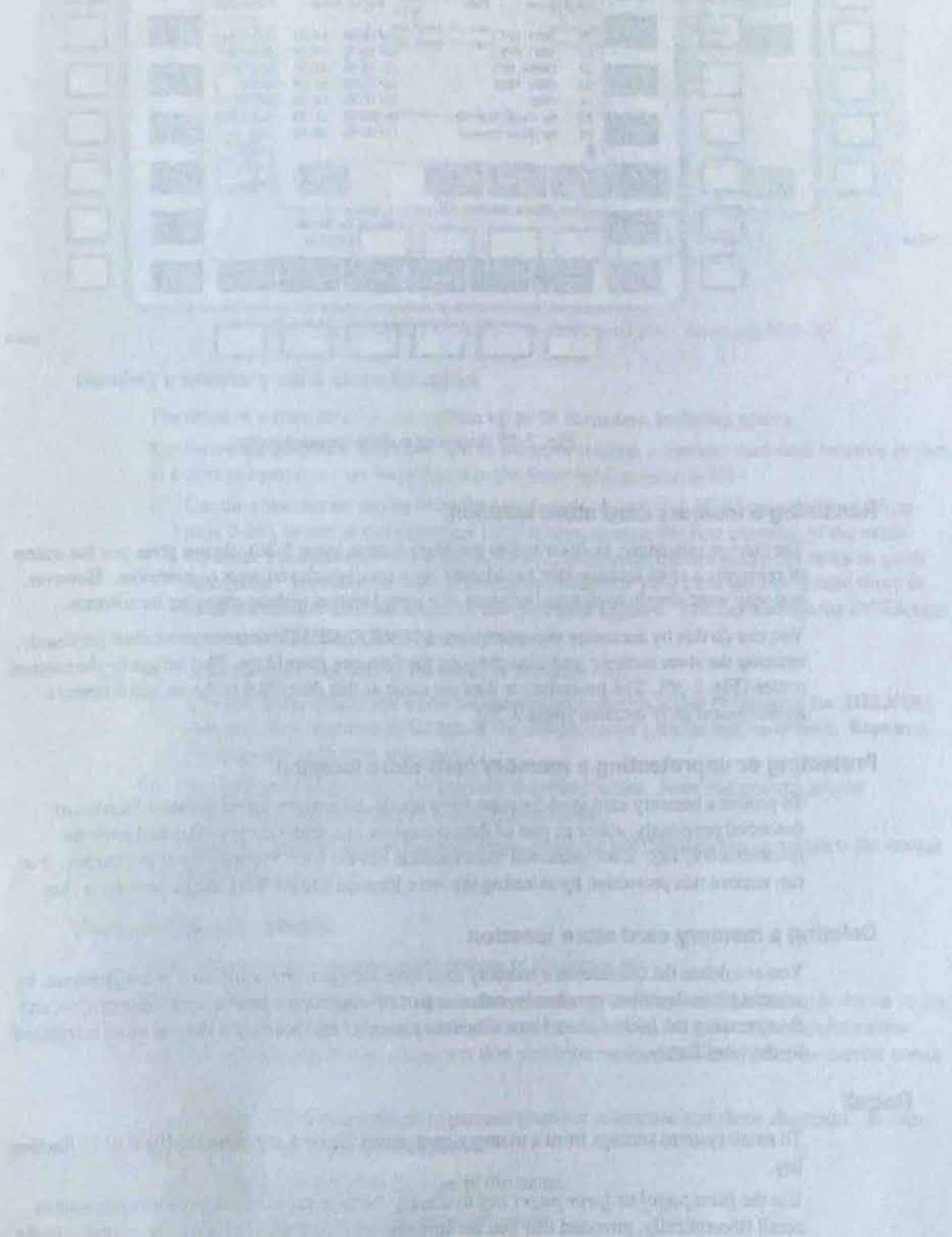
Use the [next page] or [prev page] key to display the page showing the store that you want to recall (theoretically, provided that you are sure that you know the required store number, you do

not need to do this, but it is usually safer to at least check the store title and data type before recalling it). Enter the store number using the numerical DATA keys and then press the ENTER data key. The data recalled from the memory card will overwrite the existing data (see the Note below).

The test set mode and display then reverts to that which was active before pressing the [RECALL] key.

**Note**

If you recall systems settings, remember that settings for *all* systems are recalled, not just the currently selected system.



## Error, warning and information messages

There are a number of error, warning and information messages associated with the store facility which will be displayed under certain conditions. These are listed below:-

### Error Messages

Message	Explanation
Memory Card Error Store is empty	The test set could not read data from the selected store because no information was stored in it. Data must be stored to a memory card store before it may be recalled.
Memory Card Error Store is protected	The selected store is protected to prevent it being overwritten. Use the [ <i>unprot store</i> ] key to unprotect the store. Note that any new data saved to the store will overwrite the existing data.
Memory Card Error No Card present	The test set was unable to detect a memory card in the memory card slot. Remove and reinsert the memory card. If this does not cure the problem the memory card may be faulty.
Memory Card Error Wrong format	The memory card in the memory card slot has the wrong format and may contain data from a different instrument or system. To use the memory card with this instrument it can be reformatted using the [ <i>FORMAT CARD</i> ] key. Note that all data previously stored on the card will be lost.
Memory Card Error Card directory is full	The directory on the memory card is full therefore no more data can be stored on the card. Delete unwanted data from the card using the [ <i>delete store</i> ] key.
Memory Card Error Card FAT is full	The File Allocation Table on the memory card is full therefore no more data can be stored on the card. Delete unwanted data from the card using the [ <i>delete store</i> ] key.
Memory Card Error File not found	The test set could not find a file on the memory card and is unable therefore to read back data. The memory card data may be corrupted or the memory card may be faulty. It will not be possible to retrieve the data.
Memory Card Error Store is too big to fit on Memory Card	There was insufficient blank memory on the card to store the data. Delete unwanted data from the card using the [ <i>delete store</i> ] key.
Memory Card Error User aborted store	The user hit the [ <i>ABORT STORE</i> ] key while the test set was in the process of saving data to the memory card.
Memory Card Error Unknown Error	An unknown error occurred with the memory card preventing the current operation from being carried out. Remove and reinsert the memory card. If this does not cure the problem the memory card may be faulty or the data stored in it may be corrupted.

**Warning Messages**

Message	Explanation
Memory Card Formatting in progress. Please wait	The test set is formatting the memory card because the <b>[FORMAT CARD]</b> key has been pressed. Memory card formatting takes a few seconds during which the test set may not be used.
Memory Card Formatting is finished	The test set has finished formatting the memory card and the test set may now be used.
Memory Card not present	The test set has detected that the memory card is not present in the memory card socket.
Memory Card is present Please wait while reading format	The test set requires a few seconds to read the format of a memory card when it is inserted into the memory card socket and the test set may not be used during this time.
Memory Card not inserted properly	The test set has detected that the memory card is not inserted in the socket correctly. Check that the memory card is pushed fully into the socket.

**Information Messages**

Storing data to or recalling data from the internal stores or a data card takes a few seconds, during which time the test set may not be used. An information message from the list below is displayed during this period.

Storing Instrument Settings to internal memory. Please wait.	Recalling Instrument Settings from internal memory. Please wait.
Storing Instrument Settings to Memory Card. Please wait.	Recalling Instrument Settings from Memory Card. Please wait.
Storing Instrument Results to Memory Card. Please wait	Recalling Instrument Results from Memory Card. Please wait.
Storing BASIC Program to Memory Card. Please wait.	Recalling BASIC Program from Memory Card. Please wait.
Storing Systems Settings to Memory Card. Please wait.	Recalling Systems Settings from Memory Card. Please wait.
Storing Systems Results to Memory Card. Please wait.	Recalling Systems Results from Memory Card. Please wait.

## Appendix A GLOSSARY

This glossary provides additional information about TETRA terms and abbreviations used in this manual.

### **System Types**

<b>TETRA</b>	TERrestrial Trunked RAdio (Formerly Trans European Trunked RAdio)
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### **TETRA Equipment Types**

<b>BS</b>	Base Station
<b>MS</b>	Mobile Station

### **Basic Channel Types**

<b>MCCH</b>	Main Control Channel
<b>TCH</b>	Traffic Channel (generic term)
<b>TCH/S</b>	Traffic Channel for Speech
<b>TCH/7.2</b>	Traffic Channel for 7.2 kbit/s data
<b>TCH/2.4</b>	Traffic Channel for 2.4 kbit/s data
<b>TN</b>	Timeslot Number

### **Basic System Parameters**

<b>BCC</b>	Base station Colour Code 0 to 63
<b>ECC</b>	Extended Colour Code = MCC + MNC + BCC, generates scrambling seq.
<b>DCC</b>	Direct Mode Colour Code (30 bits substitute for ECC In direct mode)
<b>LAC</b>	Location Area Code 00000 to 16383
<b>MCC</b>	Mobile Country Code (E.212, 10 bit binary) 000 to 999
<b>MNC</b>	Mobile Network Code (14 bit binary) 00000 to 16383

### **Basic Identities**

<b>ITSI</b>	Individual Tetra Subscriber Identity
<b>TEI</b>	TETRA Equipment Identity

### **Measurement Terms**

<b>BER</b>	Bit Error Rate (applies to circuit mode data & speech class 0 / 1 bits)
<b>TDMA</b>	Time Division Multiple Access
<b>T1</b>	Test signal (wanted signal).

### **Burst Types**

<b>CB</b>	Control Burst (Uplink SCH/HU burst)
<b>NDB</b>	Normal Downlink Burst (all downlink slots except BSCH slot)
<b>NUB</b>	Normal Uplink Burst (uplink TCH & SCH/F bursts)
<b>SB</b>	Synchronisation Burst (BSCH)



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